Difference Between Resting Potential and Action Potential

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Key Difference - Resting Potential vs Action Potential

The neuron is considered as the structural unit of the nervous system. It involves the transmission of different nerve stimuli during the cell to cell communication. Neurons send messages electrochemically with the involvement of different ions. In other words, electrically charged chemicals that are the ions cause the signals. The most important ions are sodium, potassium, calcium, and chloride. The movement of these ions across the membrane that surrounds nerve cells causes two types of potentials (voltage differences); resting potential and action potential. Resting potential occurs when the neuron is at rest and no transmission of impulses takes place. **Resting potential can be defined as the difference in the voltage between the inside and outside of the neuron when the neuron is at rest.** Action potential occurs when the signals are transmitted along the axon of a neuron. Hence, **Action potential can be defined as the electrical potential change when the signal transmission occurs through the axons.** The membrane potential of the neuron (specifically the axon) fluctuates with rapid rises and falls. This is the **key difference** between resting potential and action potential.

What is Resting Potential?

Resting potential is a phenomenon that occurs within a neuron when it is at rest. In simple terms, resting potential occurs when the neuron does not involve in sending any nerve impulses or signals. Such conditions are referred to as resting potential where the neuron is at 'rest'. During this condition, the membrane of the neuron contains a difference in charges. The inside region of the membrane is more negatively charged when compared with the charge of the outside region of the membrane. Such differences in charges are normally balanced out due to the exchange of different ions across the membrane to either direction; in or out.

However, during resting potential, the balancing of charges does not occur since the ion channels that are present in the membrane do not allow the passing of certain ions. It provides passage only to K^+ (potassium ions), and inhibit the movement of Cl^- ions (chloride) and Na^+ ions (sodium). Also, the membrane inhibits the passage of protein molecules that are negatively charged and present inside the neuron. These ion channels are referred to as selective ion channels.

Apart from these channels, there is an ion pump that involves the exchange of Na^+ ions and K^+ ions across the membrane. This pump works with the utilization of energy. When it works, it allows the exchange of two K^+ ions into the neuron and three Na^+ ions out of the neuron at a time. This pump is referred to as cation active pump. During resting potential, more K^+ ions are present inside the neuron and more Na^+ ions are present outside the neuron.

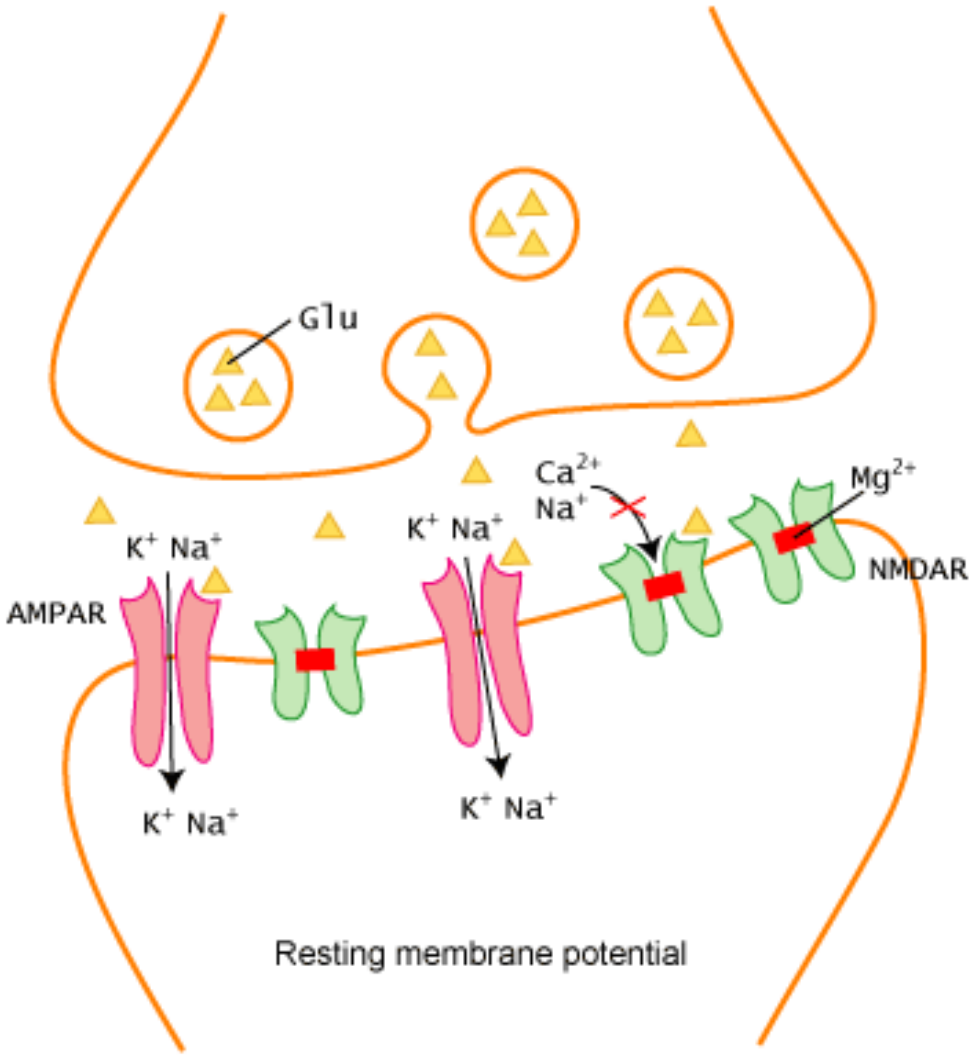

Figure 01: Resting Potential

The voltage of the resting potential (the difference in voltage between outside and inside of the neuron) is measured once all forces of charges are balanced out finally. In normal conditions, the resting potential of a neuron is -70 mV.

What is Action Potential?

Action potential occurs within a neuron when the neuron transmits impulses. During this signal transmission, the membrane potential (the difference in electrical potential between the outside and inside of a cell) of the neuron (specifically the axon) fluctuates with rapid rises and falls. Actions potentials

do not occur only in neurons. It occurs in various other excitable cells such as muscle cells, endocrine cells and also in some plant cells. During an action potential, the nerve transmission of impulses takes place along the axon of the neuron up to the synaptic knobs, located at the end of the axon. The prime role of an action potential is to facilitate the communication between cells.

Action potential is normally generated due to a depolarizing current. Due to the opening of K^+ ion channels for longer periods of time causes the voltage of the action potential to go past -70 mV. But when the Na^+ ion channels close, this value is brought back to -70mV. These conditions are known as hyperpolarization and repolarization respectively.

Action potential is normally generated due to a depolarizing current. In other terms, a stimulus that generates an action potential causes the resting potential of a neuron to decrease up to 0mV and further down up to a value of -55mV. This is referred to as the threshold value. Unless the neuron reaches the threshold value, an action potential won't be generated. Similar to resting potentials, action potentials occur due to the crossing of different ions across the membrane of the neuron. Initially, the Na^+ ion channels are opened up in response to the stimulus. It was mentioned that, during resting potential, the inside of the neuron is more negatively charged and contains more Na^+ ions outside. Due to the opening of the Na^+ ion channels during an action potential, more Na^+ ions will rush into the neuron across the membrane. Due to the + ve charge of sodium ions, the membrane becomes more positively charged and get depolarized.

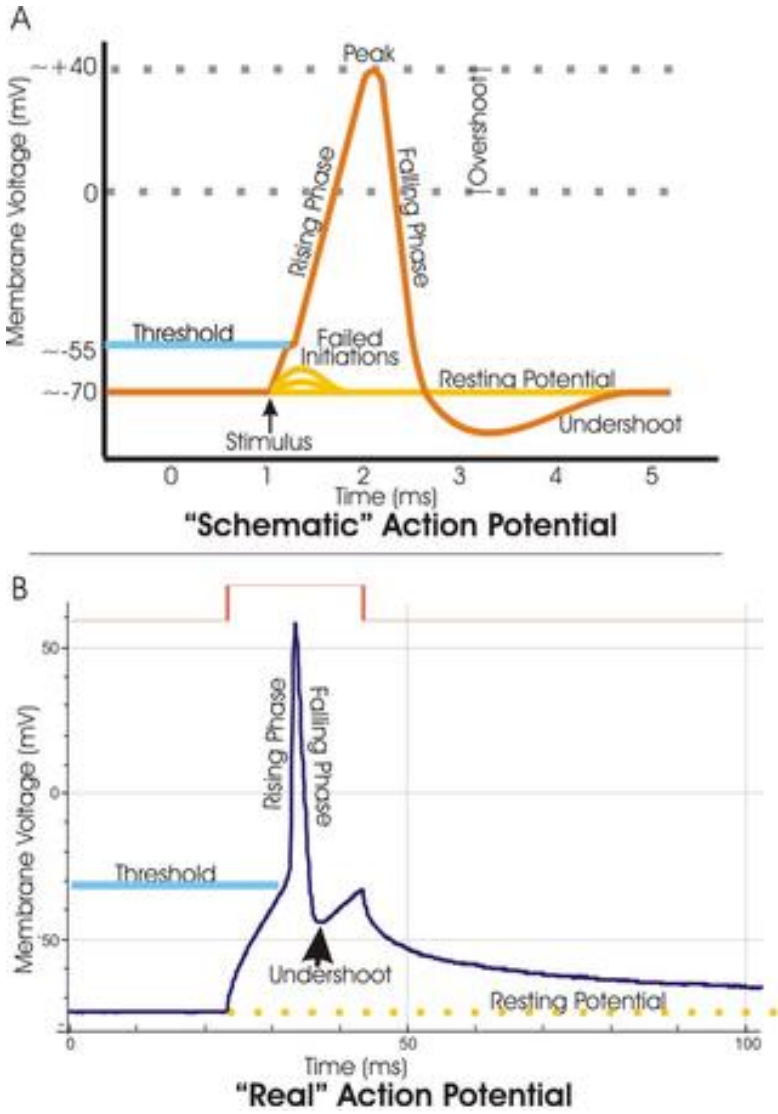

Figure 02: Action Potential

This depolarization is reversed by the opening of K^+ ion channels that move a higher number of K^+ ions out of the neuron. Once the K^+ ion channels open up, the Na^+ ion channels close. Due to the opening of K^+ ion channels for longer periods of time causes the voltage of the action potential to go past -70 mV. This condition is known as hyperpolarization. But when the Na^+ ion channels close, this value is brought back to -70mV. This is known as repolarization.

What is the Similarity Between Resting Potential and Action Potential?

- Resting potential and Action potential occur due to the movement of different ions across the membrane of the neuron

What is the Difference Between Resting Potential and Action Potential?

Resting Potential vs Action Potential	
Resting potential is the voltage difference across the neuron membrane when it is not transmitting the signals.	Action potential is the voltage difference across the neuron membrane when it is transmitting the signals along the axons.
Occurrence	
Resting potential occurs when the neuron does not involve in sending any nerve impulses or signals.	Action potential occurs when signals transmitted along the neurons.
Voltage	
-70mV is the resting potential.	+40mV is the action potential.
Ions	
More Na^+ ions and less K^+ ions outside the neurons when the resting potential occurs.	More Na^+ and less K^+ ions inside the neuron when the action potential occurs.

Summary - Resting Potential vs Action Potential

Resting potential occurs when the neuron does not involve in sending any nerve impulses or signals. The inside region of the membrane is more negatively charged when compared with the charge of the outside region of the membrane. During resting potential, more K^+ ions are present inside the neuron and more Na^+ ions are present outside the neuron. In normal conditions, the resting potential of a neuron is -70 mV. Action potential is the membrane potential when the transmission of a signal occurs along the axon. The action potential is normally generated due to a depolarizing current. Due to the opening of K^+ ion channels for longer periods of time causes the voltage of the action potential to go past -70 mV. But when the Na^+ ion channels close, this value is brought back to -70mV. These conditions are known as hyperpolarization and repolarization respectively. This is the difference between resting potential and action potential.

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