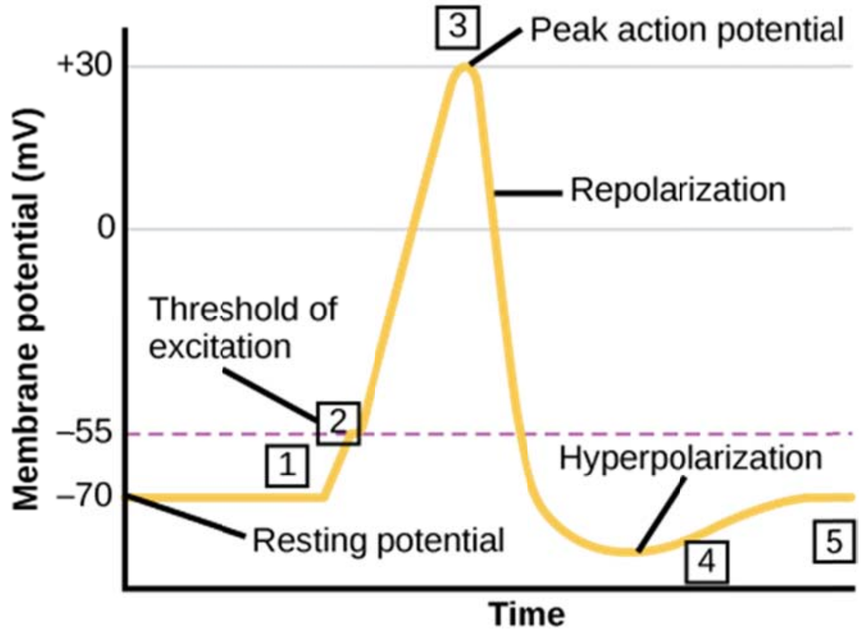
## Action Potential of Neurons

By Rene Fester Kratz from Biology Workbook For Dummies




When a neuron is inactive, just waiting for a nerve impulse to come along, the neuron is *polarized* — that is, the cytoplasm inside the cell has a negative electrical charge, and the fluid outside the cell has a positive charge. This separation of charge sets up conditions for the neuron to respond, just like a separation of charge in a battery sets up conditions that allow a battery to provide electricity.

The electrical difference across the membrane of the neuron is called its *resting potential.*

The resting potential is created by a transport protein called the *sodium-potassium pump.* This protein moves large numbers of sodium ions ($Na^+$) outside the cell, creating the positive charge. At the same time, the protein moves some potassium ($K^+$) ions into the cell's cytoplasm. Because the number of $Na^+$ ions moved outside the cell is greater than the number of $K^+$ ions moved inside, the cell is more positive outside than inside.

When a stimulus reaches a resting neuron, the neuron transmits the signal as an impulse called an *action potential.*

During an action potential, ions cross back and forth across the neuron's membrane, causing electrical changes that transmit the nerve impulse:

1. The stimulus causes sodium channels in the neuron's membrane to open, allowing the $Na^+$ ions that were outside the membrane to rush into the cell.

   The sodium channels are called *gated ion channels* because they can open and close in response to signals like electrical changes. When the $Na^+$ ions enter the neuron, the cell's electrical potential becomes more positive.

2. If the signal is strong enough and the voltage reaches a *threshold,* it triggers the action potential.

More gated ion channels open, allowing more $Na^+$ ions inside the cell, and the cell *depolarizes* so that the charges across the membrane completely reverse: The inside of the cell becomes positively charged and the outside becomes negatively charged.

3. The peak voltage of the action potential causes the gated sodium channels to close and potassium channels to open.

   Potassium ions move outside the membrane, and sodium ions stay inside the membrane, *repolarizing* the cell. The result is a polarization that's opposite of the initial polarization that had $Na^+$ ions on the outside and $K^+$ ions on the inside.

4. The neuron becomes *hyperpolarized* when more potassium ions are on the outside than sodium ions are on the inside.

   When the $K^+$ gates finally close, the neuron has slightly more $K^+$ ions on the outside than it has $Na^+$ ions on the inside. This causes the cell's potential to drop slightly lower than the resting potential.

5. The neuron enters a *refractory period,* which returns potassium to the inside of the cell and sodium to the outside of the cell.

   The sodium-potassium pump goes back to work, moving $Na^+$ ions to the outside of the cell and $K^+$ ions to the inside, returning the neuron to its normal polarized state.

http://www.dummies.com/how-to/content/action-potential-of-neurons.html