no.

Physiology

Doctor 2019 | Medicine | JU

◉ Sheet ○ Slides

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Contributed in the Scientific Correction

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Contributed in the Grammatical Correction

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Doctor

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Summation

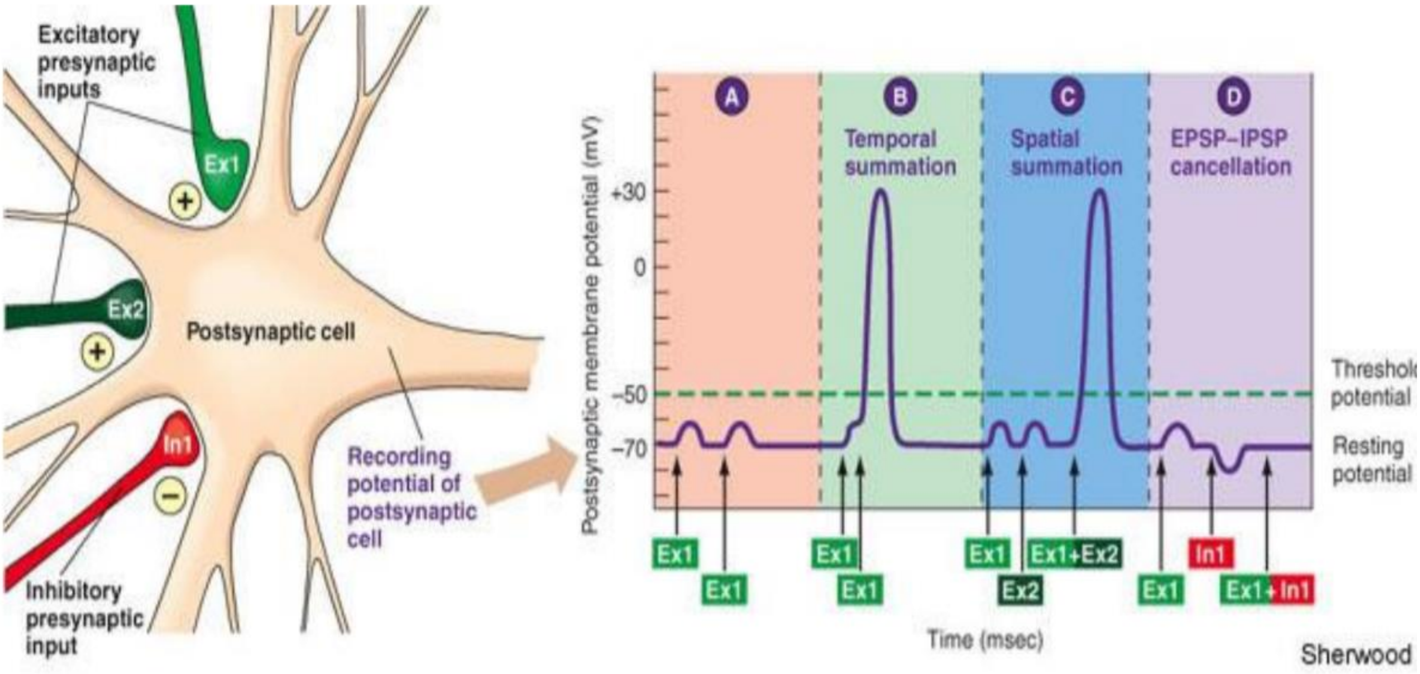
Postsynaptic neurons generate either inhibitory post synaptic potentials (IPSP) or excitatory post synaptic potentials (EPSP), a process of summation of these potentials can occur. By these processes of summation an action potential can be or can't be triggered in the axon hillock by the post synaptic neurons.

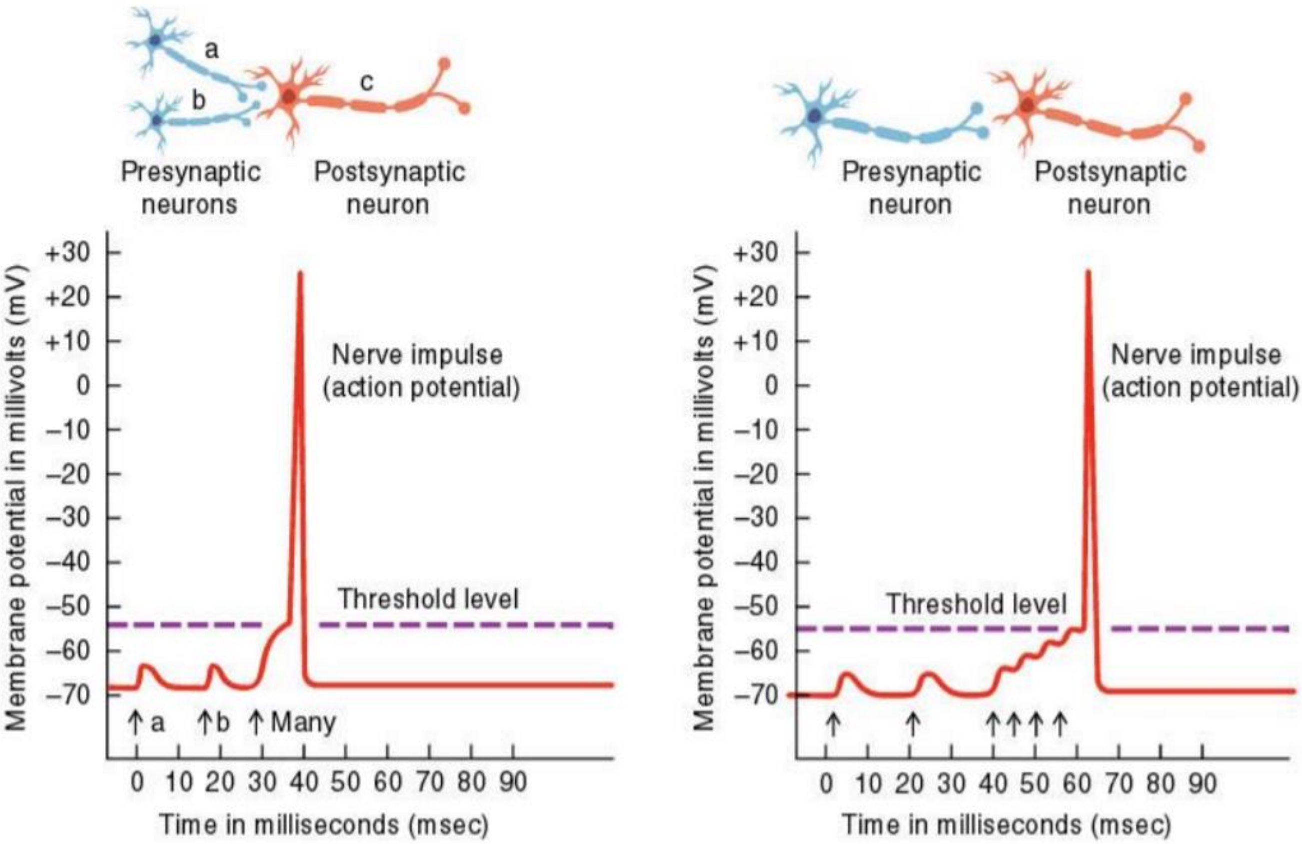
There are two types of summation:

Spatial summation	Temporal summation
(space) where two impulses from different sources arriving at the same time at the post synaptic membrane (generating two excitatory potentials which if they reach the threshold they can cause an action potential at the axon hillock)	(time) where only one presynaptic source generating more than one excitatory potential one after another at the post synaptic neuron causing more depolarization (which can reach the threshold and cause an action potential)

*You can find both spatial and temporal potentials working on one neural cell at the same time

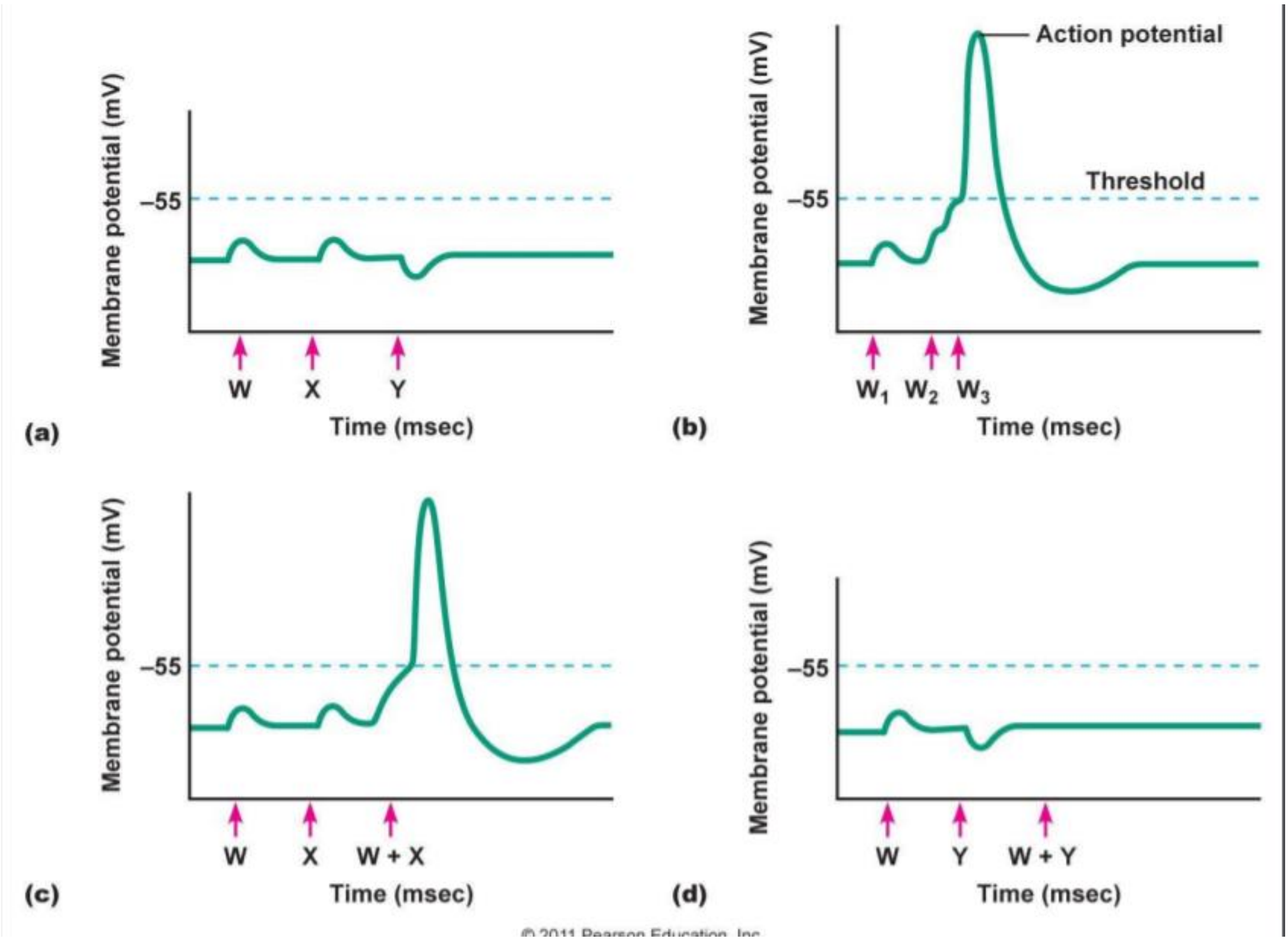
*The duration of the action potential is less than the duration of the excitatory potential (graded potential), this causes summation by linking many stimuli with each one taking a longer duration.





(a) Spatial summation

(b) Temporal summation



Synaptic organization

1. Converging circuit: many presynaptic neurons synapsing with one neural (e.g: neurons at the spinal cord)

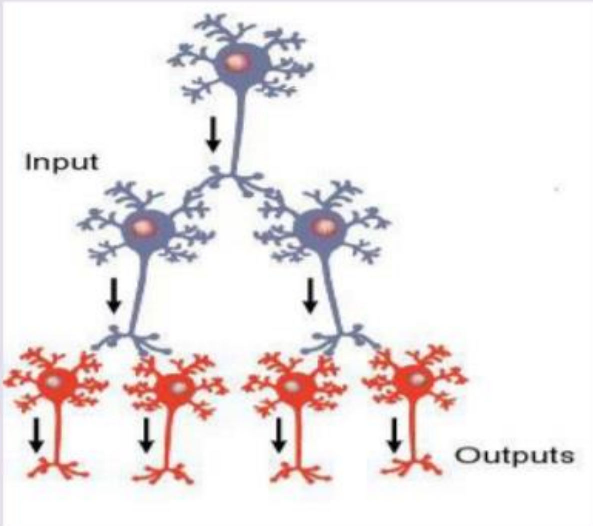
2. Diverging circuit: presynaptic neuron terminals synapsing with many post synaptic neurons. (e.g: motor neurons at muscles)

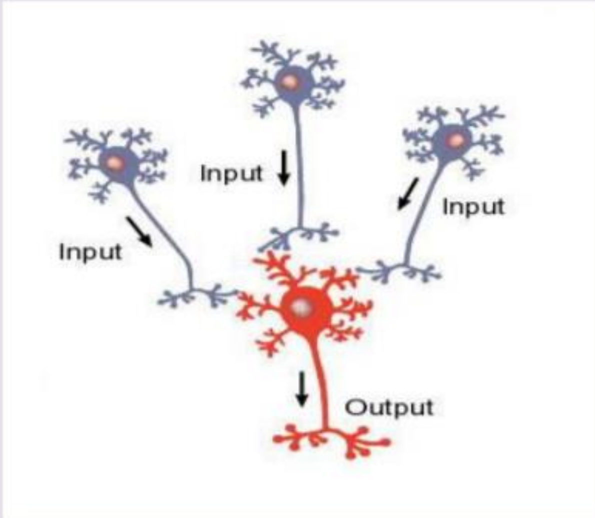
3. Reverberating circuit (eg. Neurons responsible for respiration)

4. Parallel-after-discharge circuit (e.g: reflexes)

(اخر ثنين ما انشرحوا بالمحاضره)

Divergence	Convergence
one presynaptic neuron (one axon) that has terminals synapsing with many postsynaptic neurons.	means signals from multiple inputs uniting to excite a single neuron.





Monophasic and Biphasic

- Monophasic action potential: which studies the potential difference over time by having one electrode inside the cell (intracellular) and another electrode outside the cell (extracellular).
- Biphasic action potential: we can find the potential difference by having two electrodes outside the cell (extracellular) in different parts of the neural cell. That’s by seeing the difference between a point that has action potential (depolarizing) and a point still at resting potential and with time the point with depolarization will have repolarization and the point at rest would have depolarization, this causes having two readings (waves) that are at opposite to each other. Seeing the charge of the waves is relevant to the placements of the electrodes (the first wave always represents the depolarization and the second as repolarization).

Compound potentials

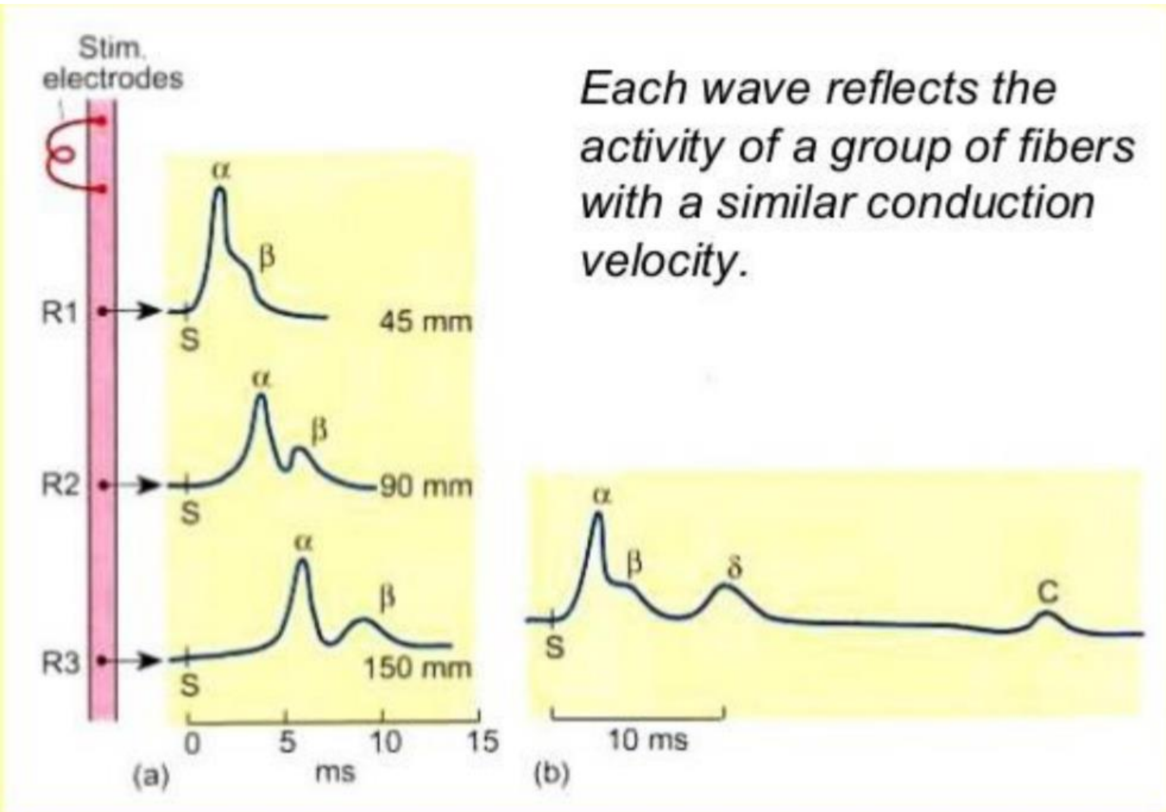
*The nerve is composed of many nerve fibers (axons), these axons have different properties (such as conductance, size,)

*We can record the action potentials at all the fibers of a neural cell by recording what we call compound action potentials.

First, to understand, can we record all action potentials in a nerve?

Yes, we can.

Assuming we stimulated that nerve by placing a stimulator at a point. By that we have generated action potentials in all nerve fibers of that nerve. Going down to record action potentials we are using one electrode only (on the nerve). The other electrode is place on a source of high resistance. (Which causes a record of 0 voltage.)

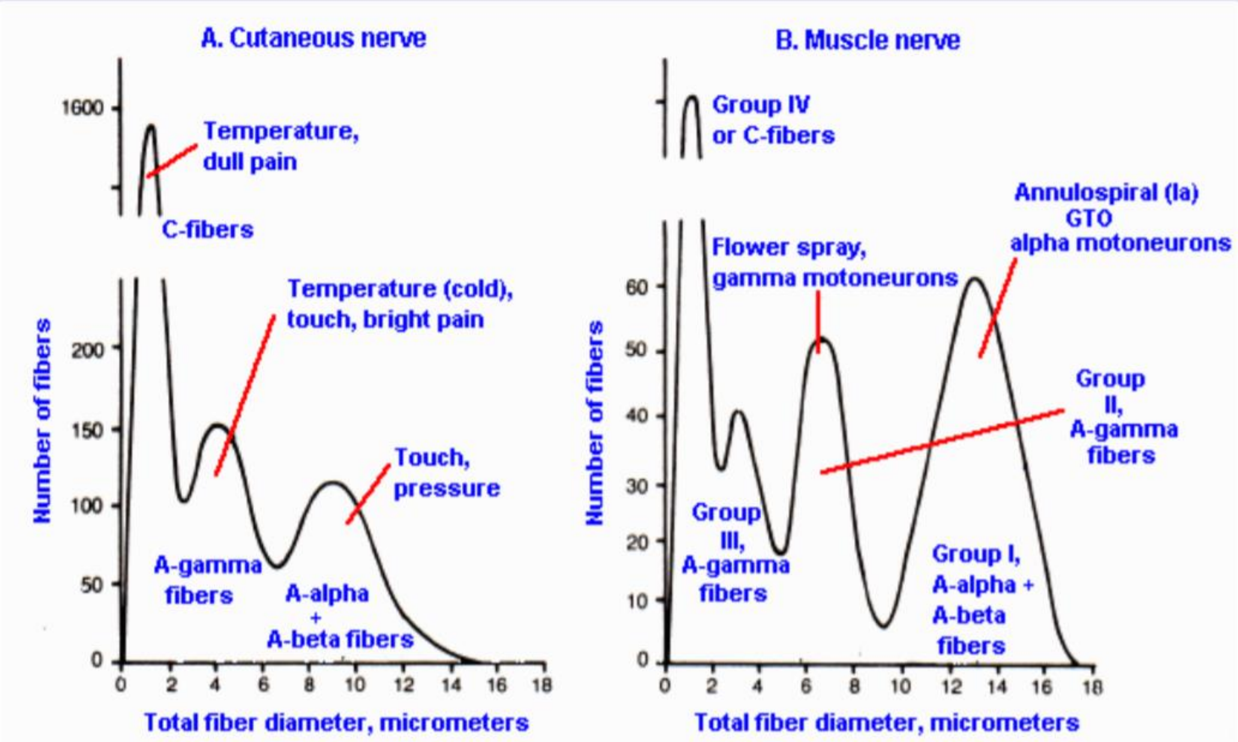


- The recording is generated by the difference on the first electrode in comparison to the other source (**the 0 voltage electrode**).

By going to a further distance along the nerve ***more*** types of recordings can be seen.

- This is caused by the presence of different types of nerve fibers along the nerve, as different types conduct impulses at varying speeds. If the recording is taken from a close distance from the stimulator some of these waves are fused together. But when the recording is done at a further distance, as fibers conduct impulses at different speeds (some might be faster while others are slower) different waves or recordings are shown.

(**C wave** shown represent action potentials generated in fibers of lower speed while **alpha waves** shown represent recordings of fibers of higher speed)



The figure above shows examples of compound action potentials from different types of cells.

- Different types of fibers will be taken later with doctor faisal (alpha fibers c fibers etc) As you know some fibers are motor others are for sensation, and so on.

● If it is intended to check the integrity of neural activity of a nerve, as it is done in hospitals, the nerve is stimulated and the sum of action potentials are recorded at different distances, to know if a certain type of fibers is working properly.

● This recording of all action potentials in a nerve is called the recording compound action

potential. Which is the recording of the sum of all action potentials in a nerve.

- You are expected to understand the principles and concepts. You won't be asked about the details or to analyze different recordings as numerous experience and knowledge is needed for this purpose. For example as needed to differentiate between recordings of a healthy person from the recordings of a person suffering an illness.

Excitability of Cells

As you know not all excitable cells in our body as the same, as they have differences. For example, the neural and muscle cells have different properties. Those differences might be in membrane potential or threshold potentials within all of these tissues.

For example, the differences in the number and distribution of voltage gated sodium channels per area in a membrane. As higher number indicates a higher chance to stimulate these channels if these channels are in the **closed and capable of opening**

state. Which affects the threshold as higher number of channels that are available is correlated to lower threshold.

Within the same number and distribution of sodium channels, a more negative membrane potential indicates higher excitability because the more negative the potential, the more sodium channels are in the state of closed and capable of opening, while at a less negative membrane potential a higher percentage of channels are in the state of closed and incapable of opening than in a more negative membrane potential.

Another factor to take in mind is how close are the threshold and the membrane potential.

For example, if the threshold of two membranes is fixed at -55, a membrane of -70 needs a weaker stimulus to reach threshold than a membrane of -90, and thus is more excitable.

Remember that all of those factors are **relative** and depend on each other. Thus many factors play a role in determining excitability. But generally cells with a more negative membrane potential tend to be more excitable than other types of tissues.

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