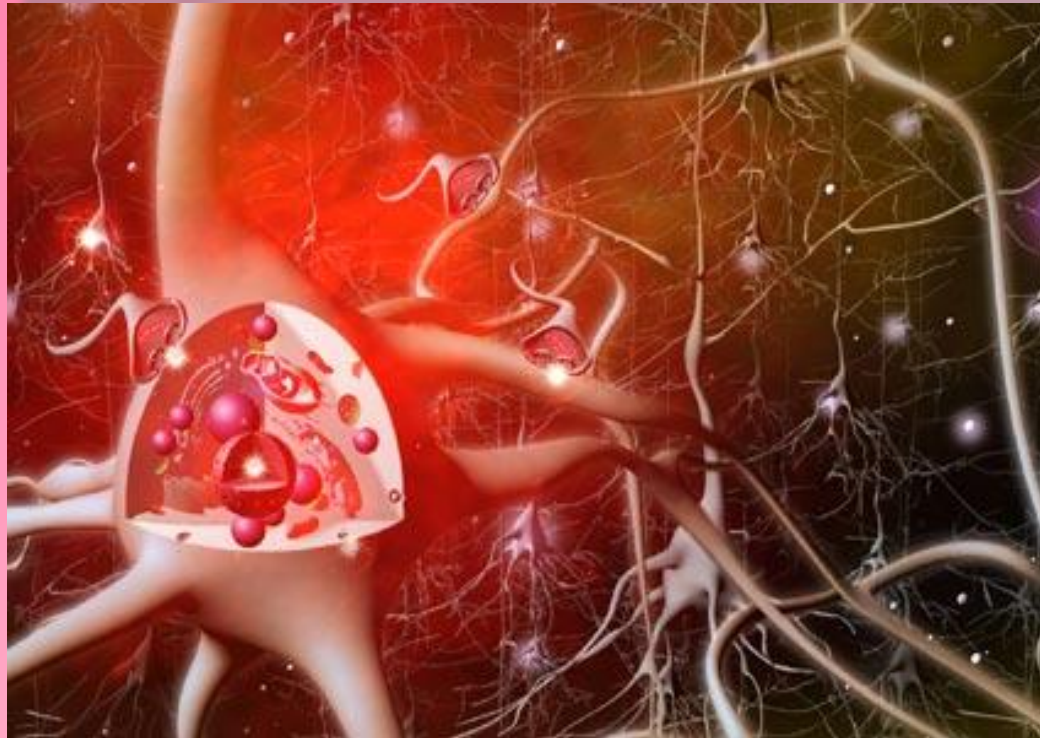


Synapse 2 (PY 10.2)



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Learning objectives

At the end of this class, the student should be able to:

- Enumerate & describe the properties of synapse .

Presynaptic inhibition

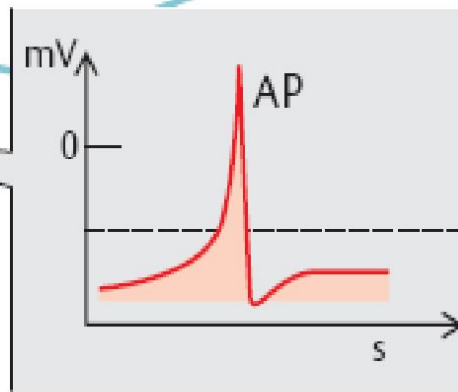
1 Uninhibited

e.g. Ia afferent

Inhibitory interneuron

Stimulatory transmitter

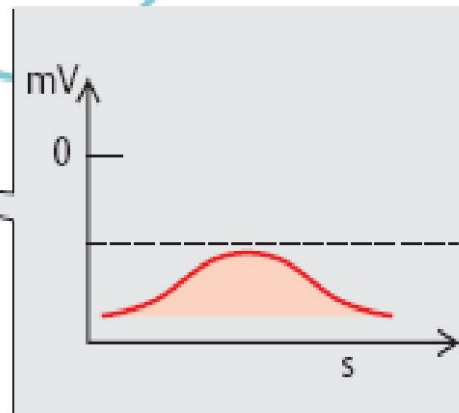
e.g. α motoneuron



2 Inhibited

Inhibitory transmitter

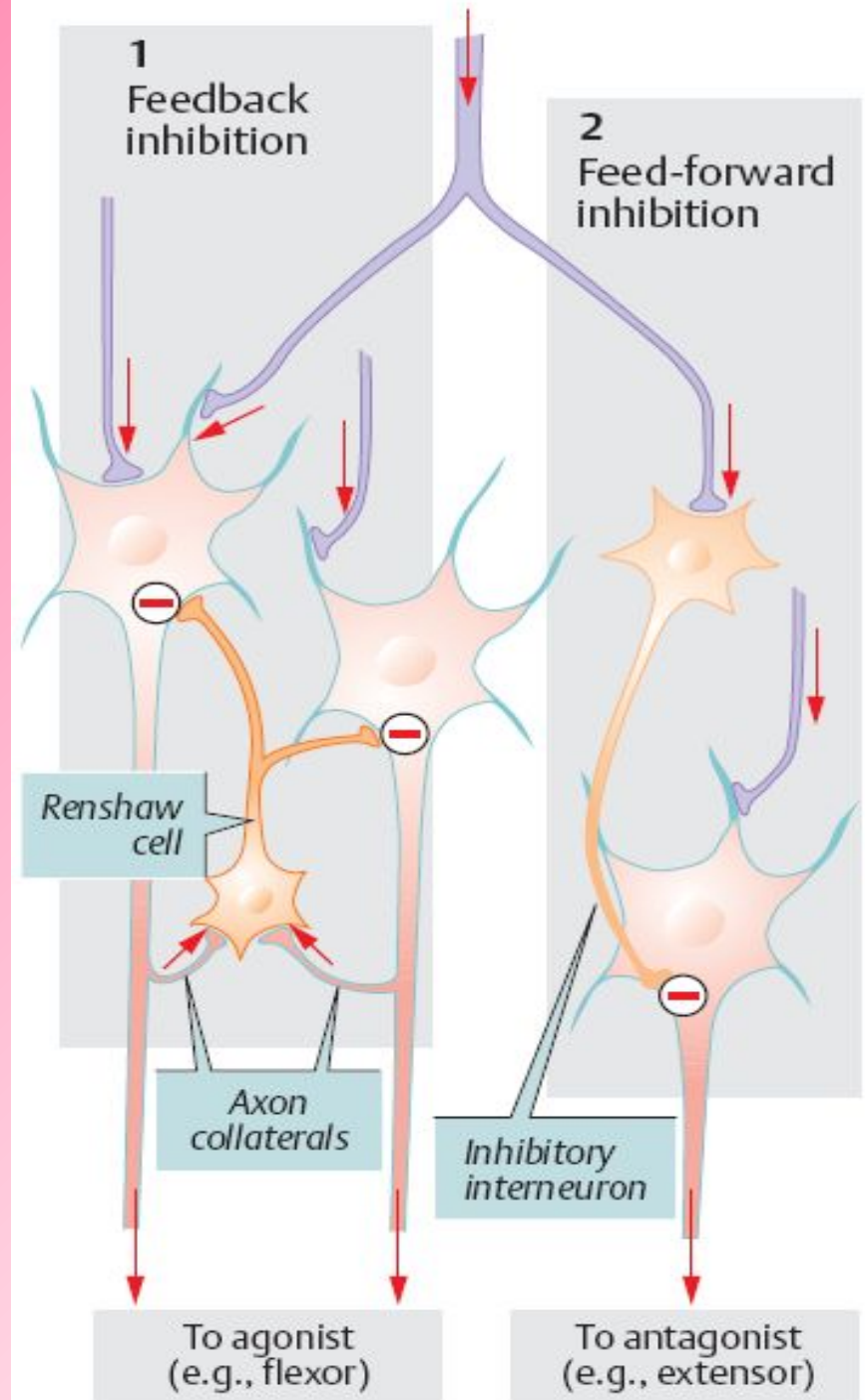
Stimulatory transmitter



Post synaptic Inhibition - Direct

- Direct release of inhibitory neurotransmitter

Post synaptic Inhibition Indirect – Renshaw cell



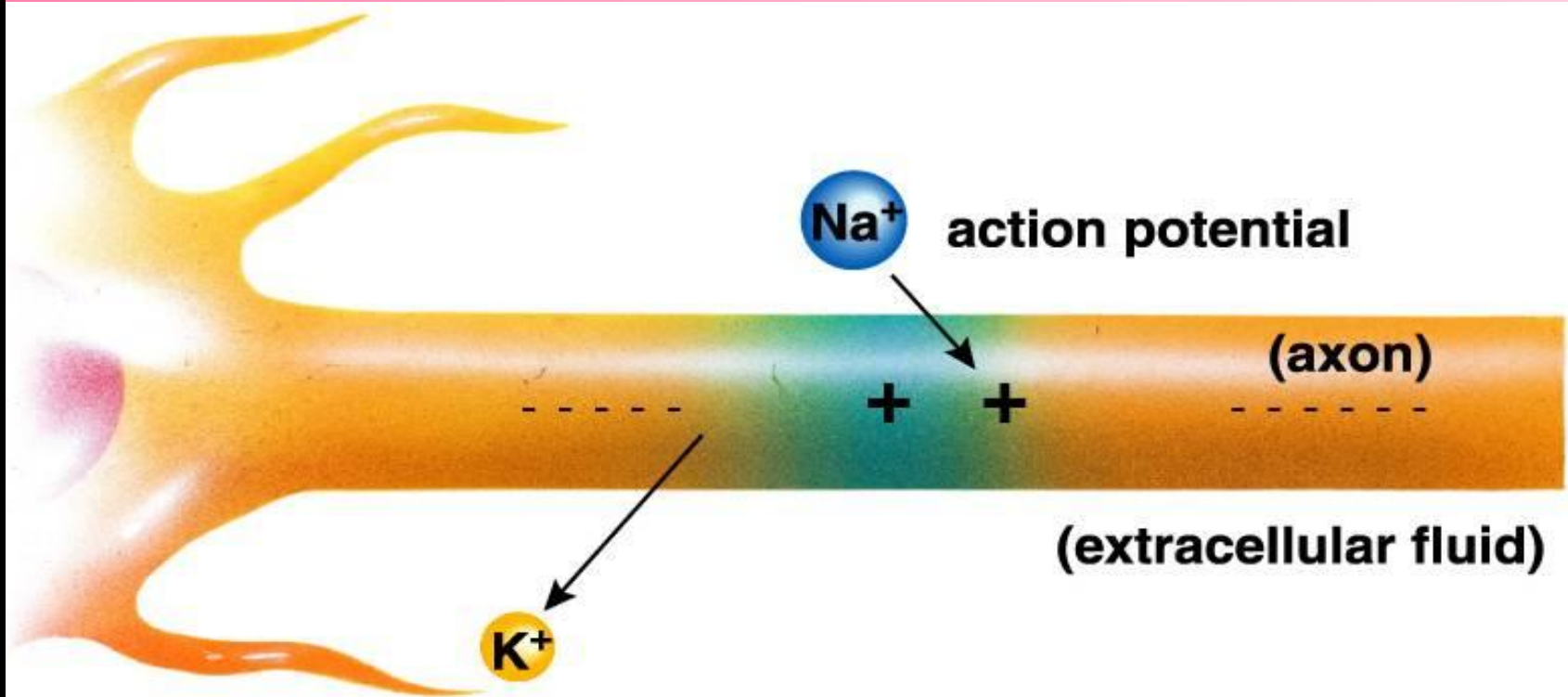
SYNAPTIC INHIBITION

- Significance:
- Restriction over neurons & muscles to react properly & appropriately.
- Helps to select exact number of impulses & block the unnecessary ones

Properties of synapses

1. One way conduction
2. Synaptic delay
3. Divergence & convergence
4. Summation
5. Occlusion
6. Subliminal fringe
7. Fatigue
8. Reciprocal inhibition
9. Reverberation
10. Plasticity
11. Effect of hypoxia
12. Effect of acidosis/alkalosis

1) Law of forward conduction (one way conduction)

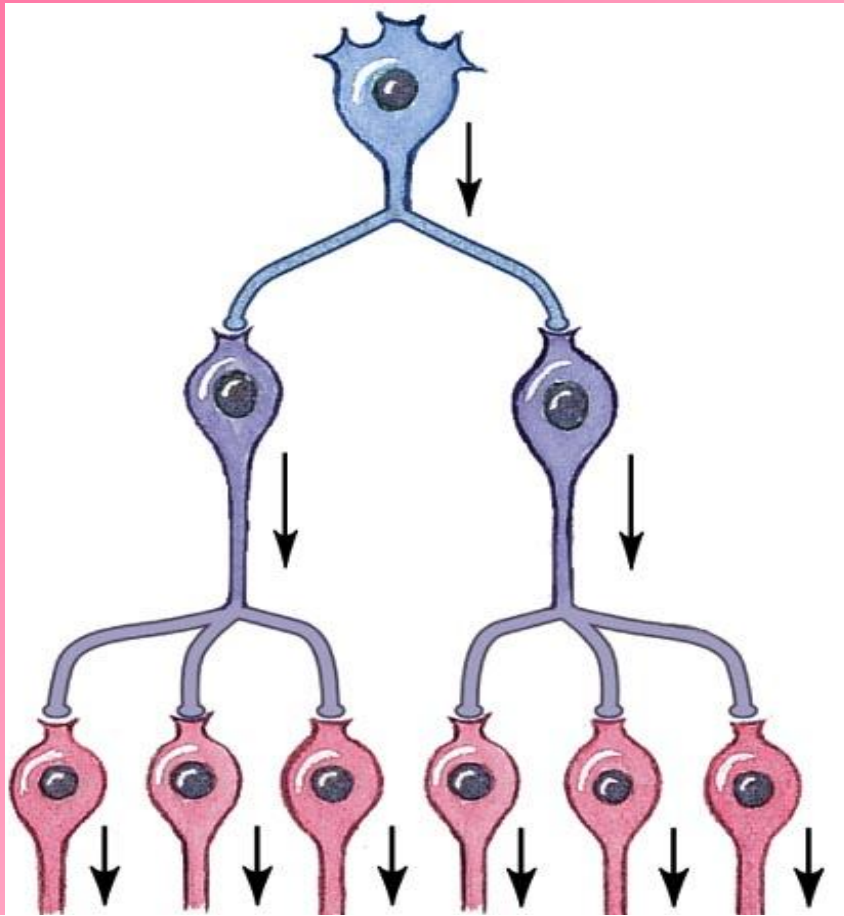


- Always from presynaptic to postsynaptic terminal only(unidirectional)
- Significance: maintains conduction in one direction only

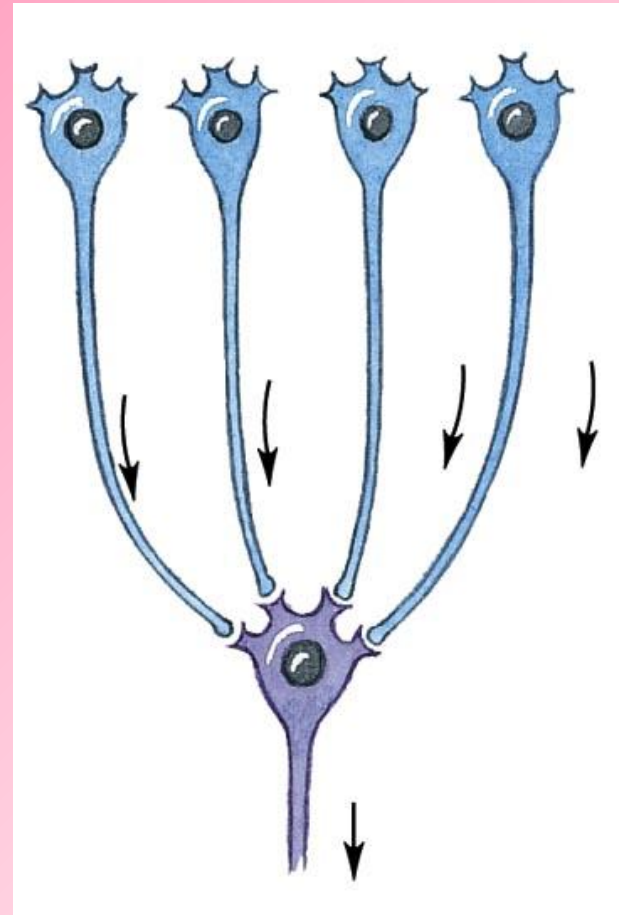
2) Synaptic Delay

- Time required for impulse to pass from presynaptic to postsynaptic terminal
- Cause:-
 - NT release
 - Action on post synaptic receptors
 - Changing the permeability
 - Na⁺ influx
 - AP generation

3) Divergence & Convergence



Divergence
Corticospinal tract

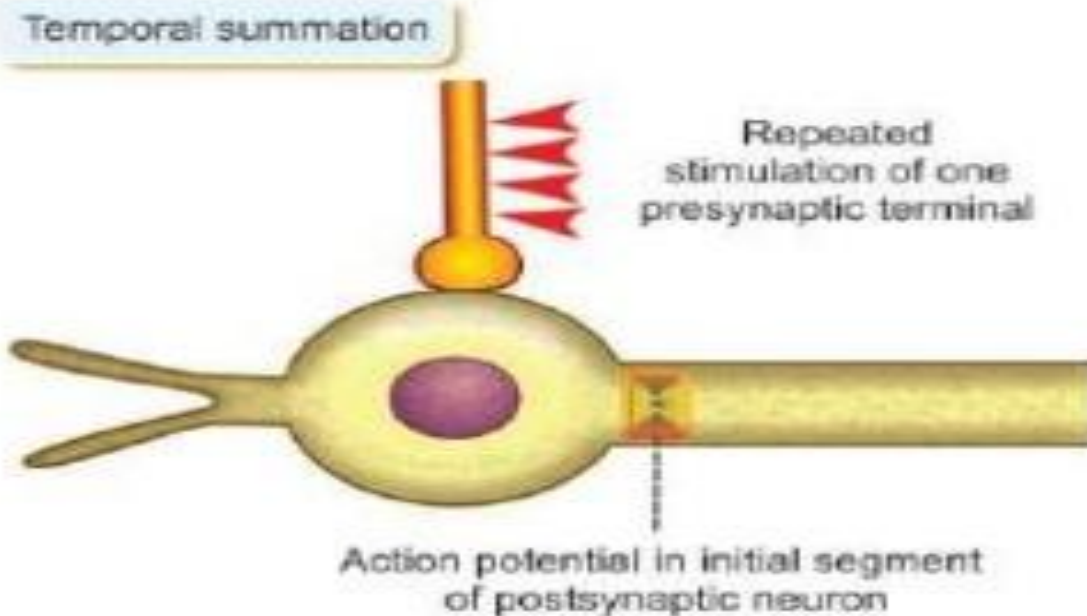


Convergence
Sp. Motor neuron

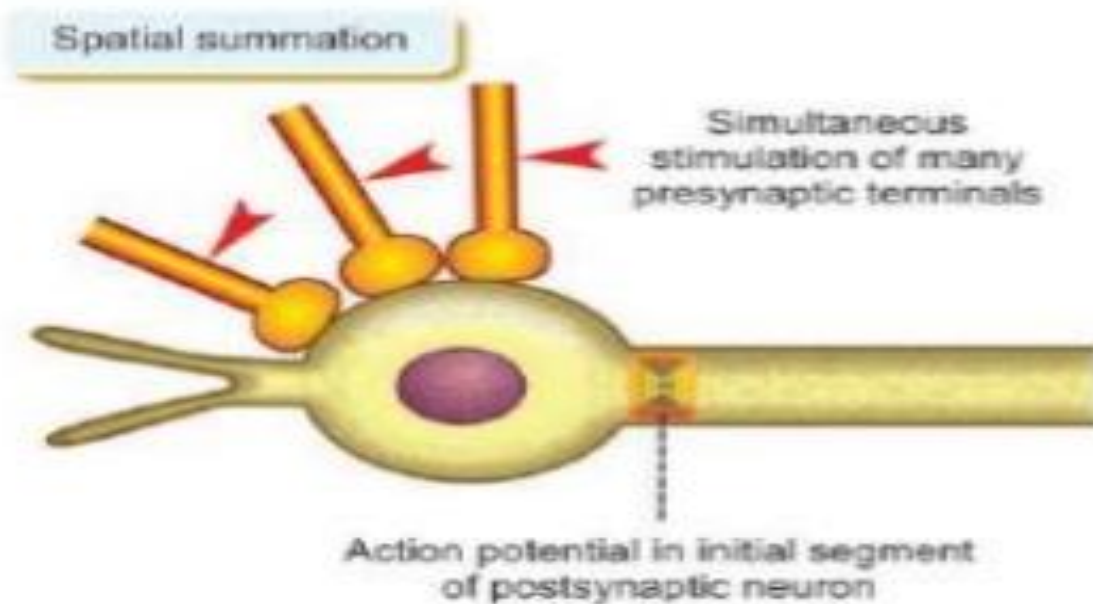
4) Summation

- EPSP is graded potential
- Does not follow all or none law
- Subliminal stimulus can be summated.

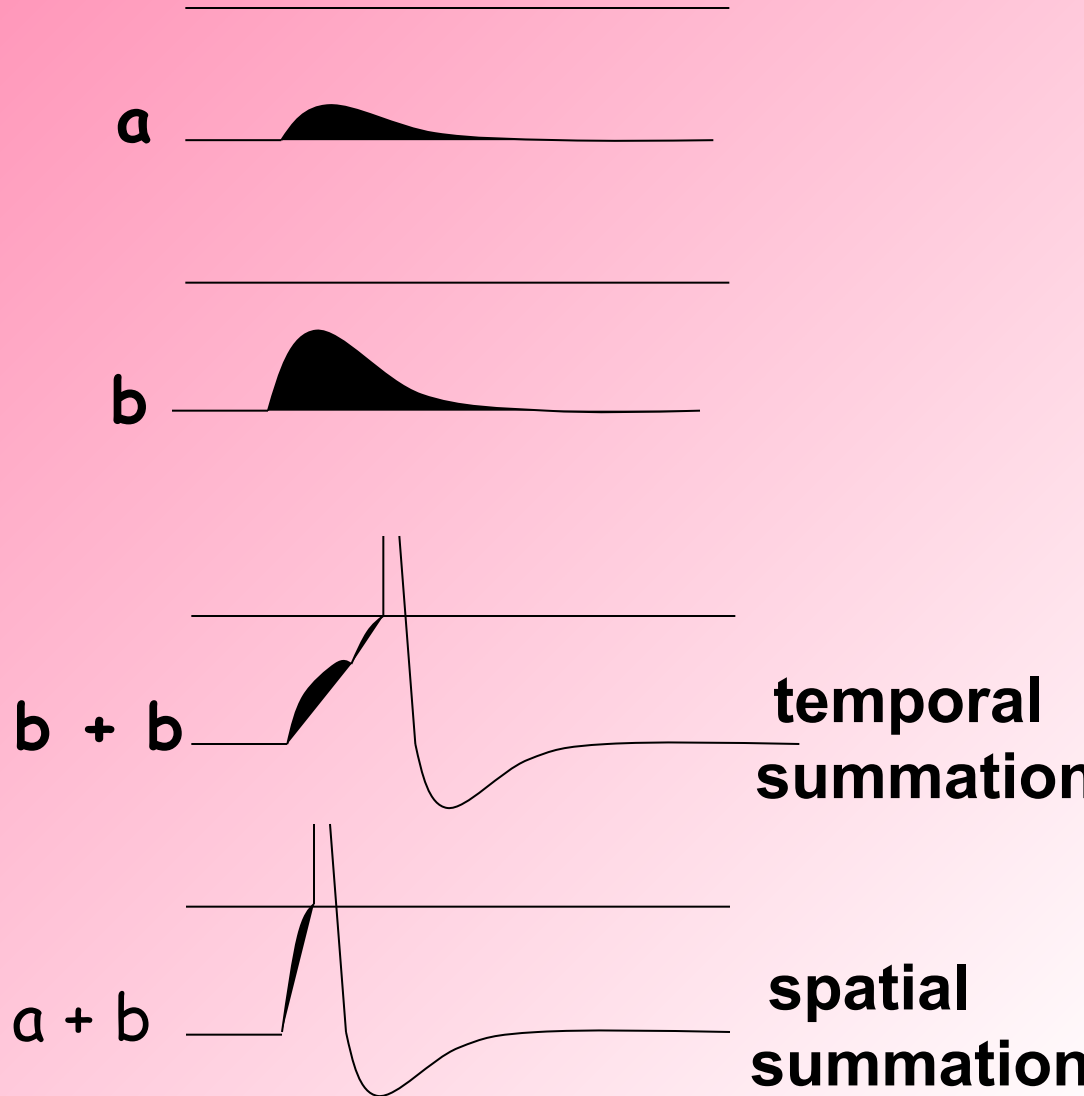
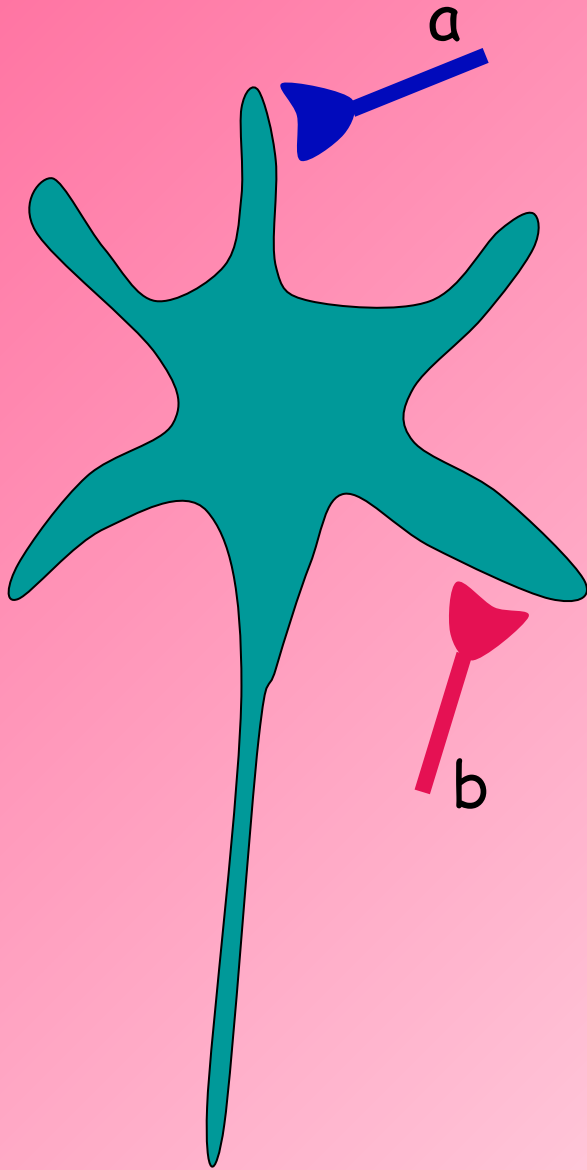
► TEMPORAL SUMMATION



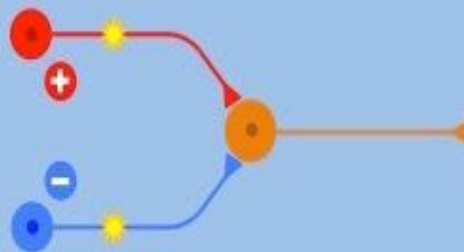
► SPATIAL SUMMATION



4) Summation

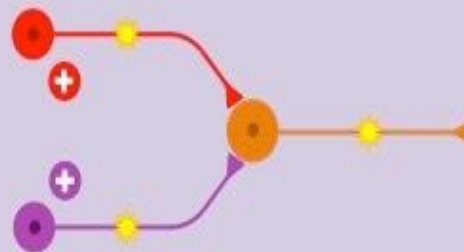
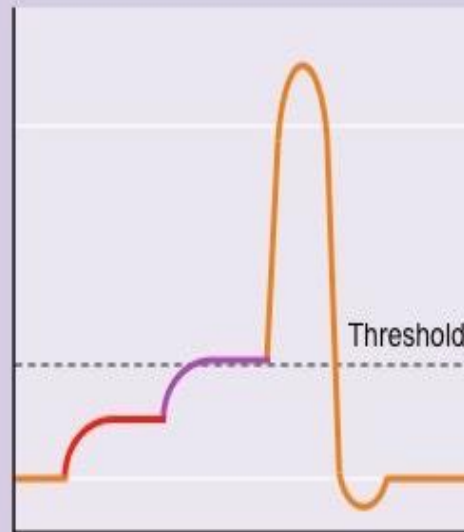


EPSP-IPSP Cancellation



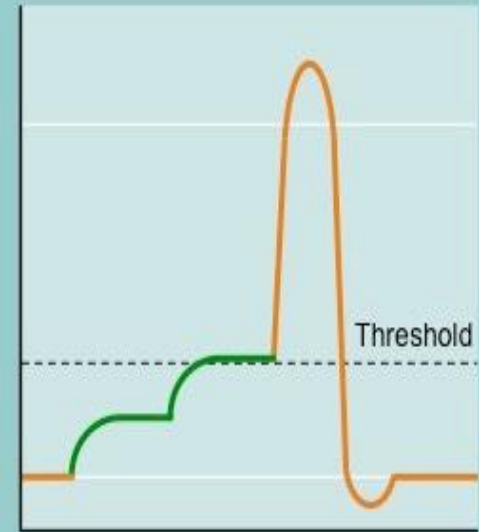
Excitatory and inhibitory graded potentials **cancel** each other out

Spatial Summation



Excitatory potentials from **many** neurons trigger threshold point

Temporal Summation



Many excitatory potentials from **one** neuron triggers threshold point

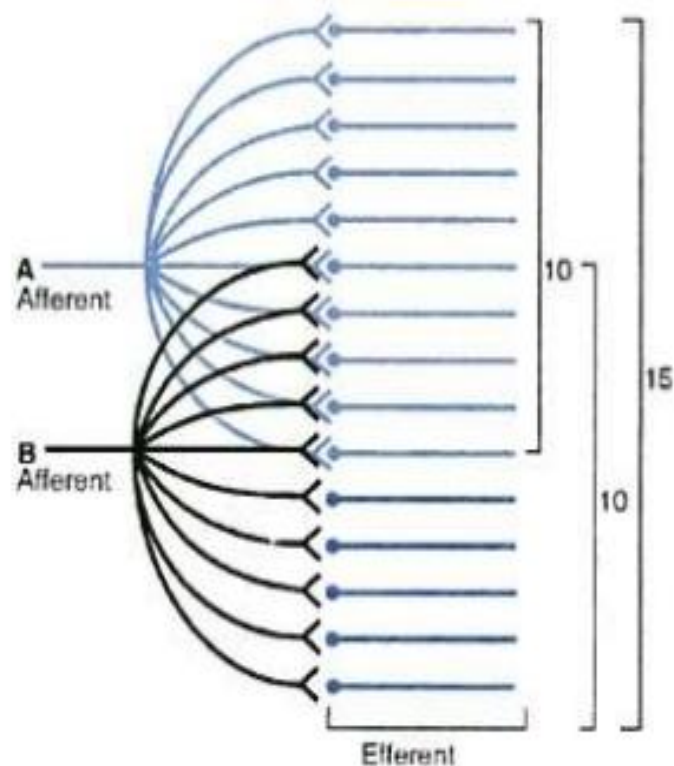


Fig. 10.2-7. Occlusion phenomenon: Stimulation of afferent neuron A and B each excites 10 efferent neurons. Simultaneous stimulation of neuron A and B together excite 15 efferent neurons because 5 efferent neurons are common to both.

- Response of simultaneous stimulation of A & B presynaptic neurons is less than the mathematical total when A & B are stimulated separately.

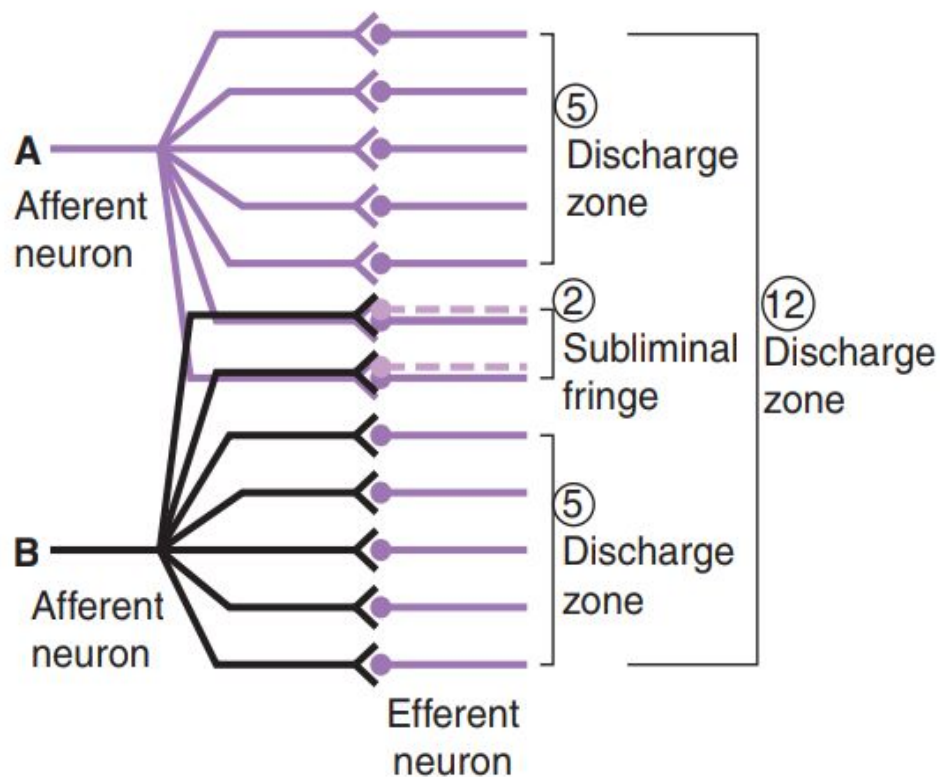


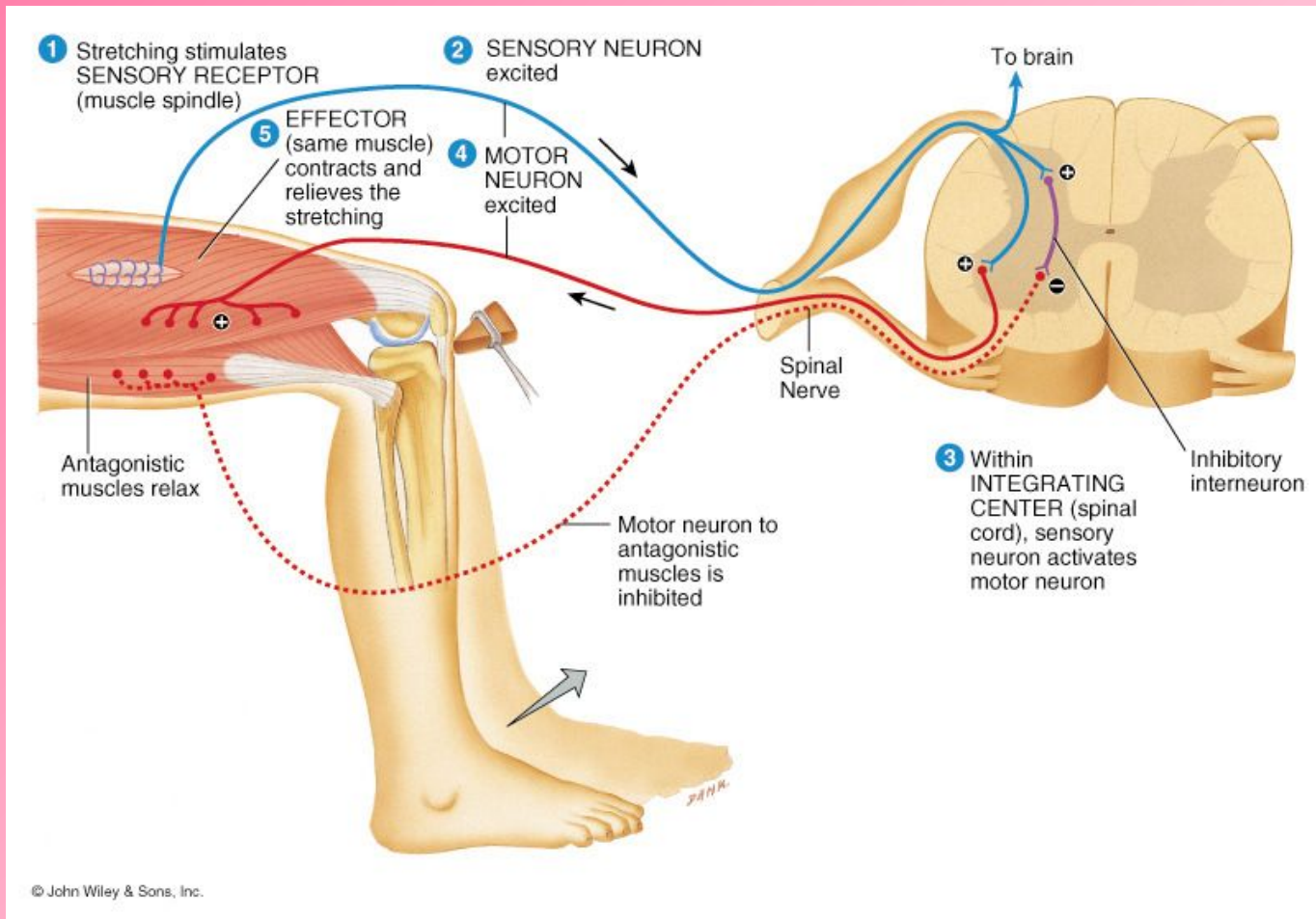
Fig. 10.7-12 Subliminal fringe effect: stimulation of afferent neuron A and B each excites five efferent neurons and subliminal fringe effect on two efferent neurons (which are common to both A and B neurons). Simultaneous stimulation of neuron A and B together excites 12 efferent neurons because the subliminal fringe effect on two neurons gets summated to produce threshold stimulation.

- Response of simultaneous stimulation of A & B presynaptic neuron is more than the sum total of response when they are stimulated separately

7) Fatigue

- Repeated stimulation of excitatory neurons at rapid rate decreases the no. of discharges progressively
- Mechanism:-
 - Exhaustion of NT
 - Progressive inactivation of postsynaptic receptors
 - Accumulation of waste products
- Site of fatigue in CNS is synapse

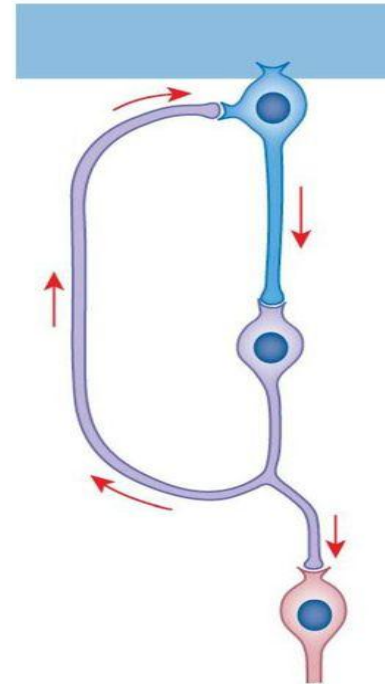
8) Reciprocal inhibition



Reverberation

Reverberation

- Collateral branches of axons along circuit; extend back toward the source of impulse and keep stimulating presynaptic neurons
- Positive feedback loop
- Continues until synaptic fatigue or inhibitory stimuli end cycle



9) Plasticity

- Capacity of synapse being easily moulded or changed
- On the basis of past experience the synaptic conduction can be increased or decreased
- Important in learning & memory

a. Post –tetanic potentiation

b. Long –term potentiation

c. Habituation

d. Sensitization

a. Post-tetanic potentiation **(facilitation)**

- enhanced responsiveness following repetitive stimulation
- mechanism thought to be build-up of calcium ions in the pre synaptic terminals
- build-up of calcium causes more vesicular release of transmitter

b.Long term potentiation

If post tetanic potentiation gets more prolonged and lasts for many days ,it results in increase in Ca^{+} in post synaptic neuron rather than pre synaptic neuron.

Seen in Hippocampus.

Important in long term memory

c. Habituation

By non injurious stimulus

Repeated stimulus- decrease of response

Gradual inactivation of Ca^{++} channels

d. Sensitization

Noxious(injurious) stimulus- increase response

Increase in c AMP & increase in Ca^{++} in post synaptic neuron

10. Effect of hypoxia

- brain highly dependent on oxygen
- interruption of brain blood flow for 3 to 7 sec can lead to unconsciousness

11. Effect of acidosis

- depresses neuronal activity
- pH change from 7.4 to 7.0 usually will induce coma

12. Effect of alkalosis

- increases neuronal excitability
- pH change from 7.4 to 8.0 usually will induce seizures

Assignment

- Describe in detail Properties of synapse

Thank you