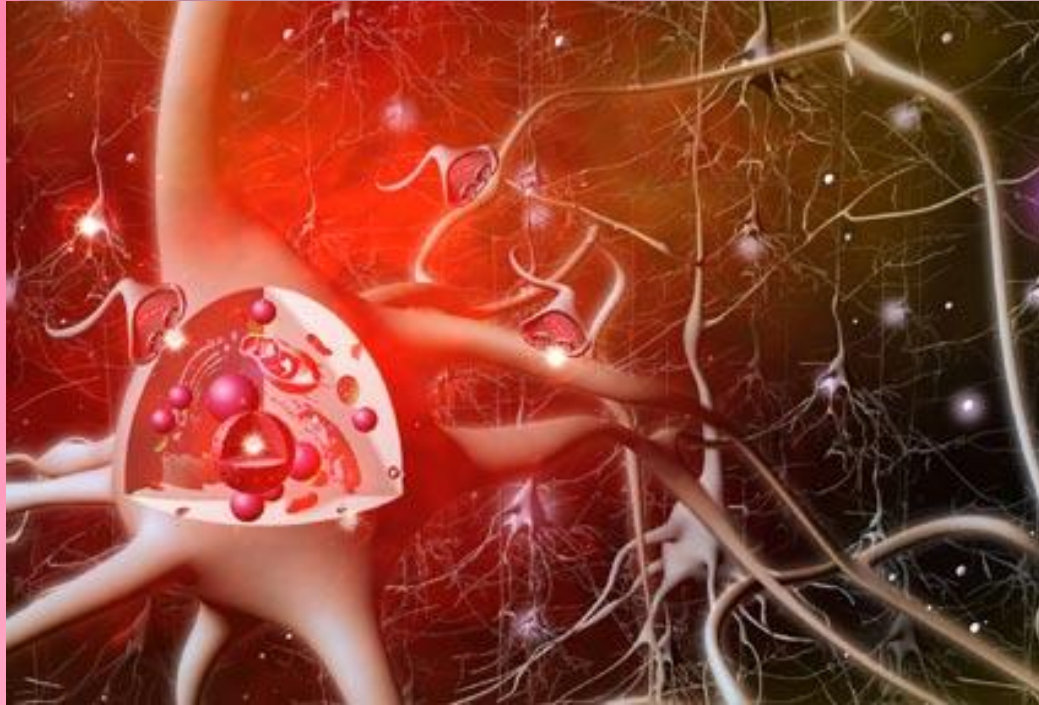


Synapse 1



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- Competency no.PY10.2

Learning objectives:-

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

- Define synapse
- Classify synapse
- Differentiate between Chemical & electrical synapses
- Explain the mode of generation of EPSP (Excitatory post synaptic potential) & IPSP (Inhibitory post synaptic potential)
- Describe the properties of synapse

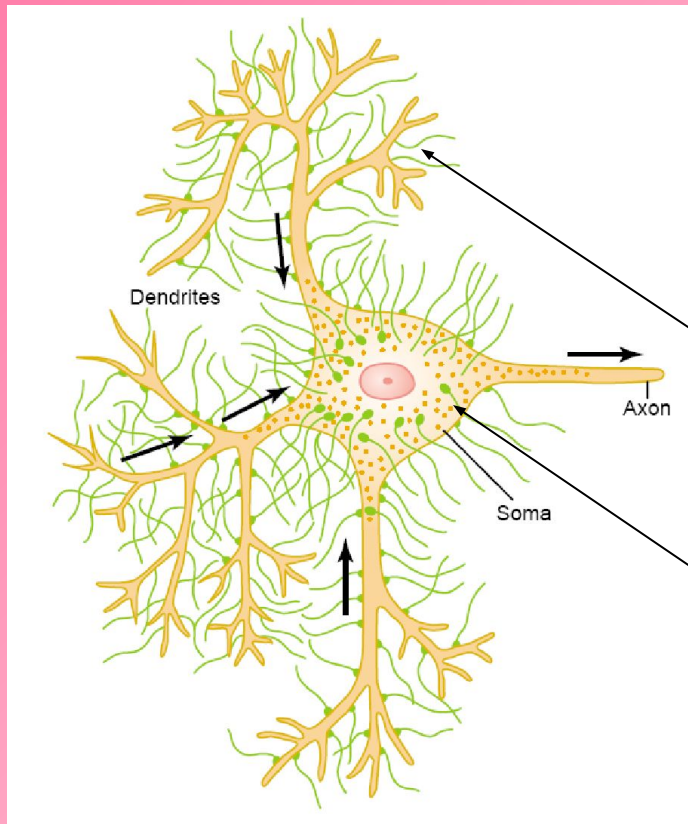
Introduction

- Definition:- Junction between the two neurons
- Term was first introduced by 'Sherrington'
- Types:-
 - Physiological
 - Chemical
 - Electrical
 - Anatomical
 - Axo - dendritic
 - Axo - somatic
 - Axo - axonic

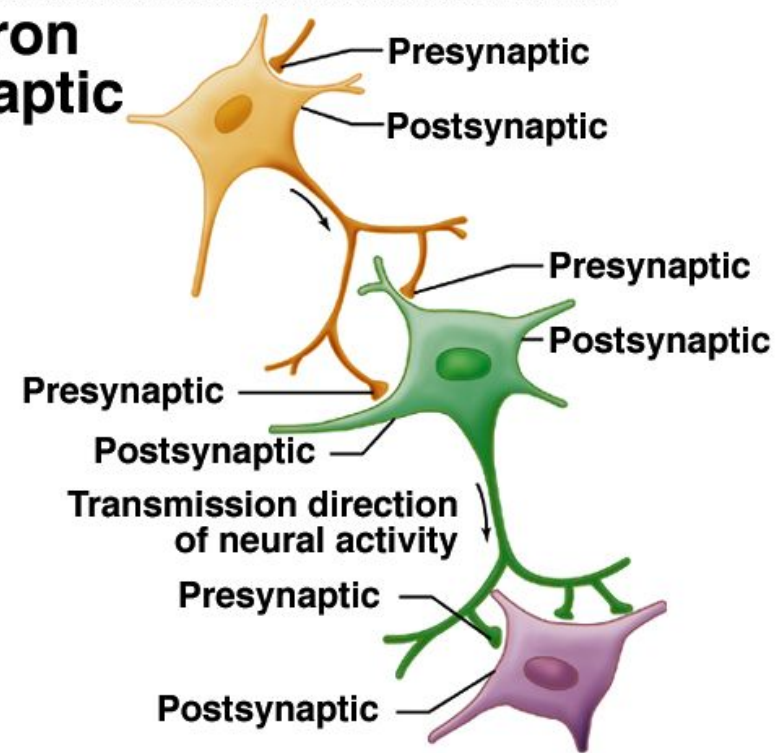
Anatomical Types

Axo – dendritic, Axo – somatic,

Axo -axonic



A neuron postsynaptic



- Axo-dendritic
- Axo-somatic

Physiological types

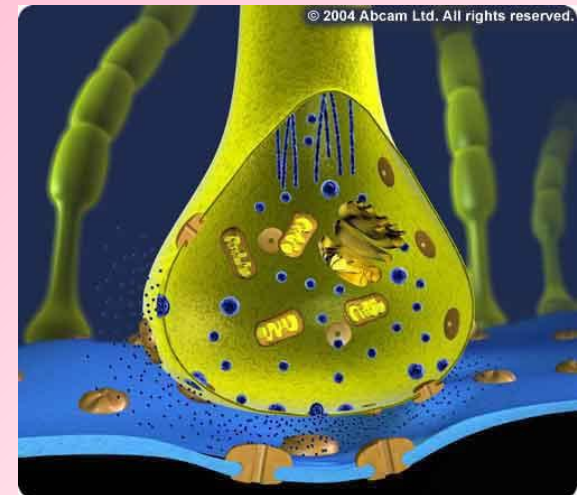
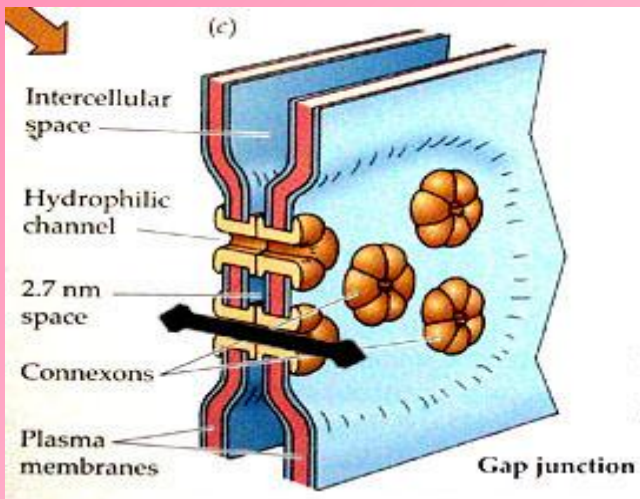
Chemical v/s Electrical Synapses

Electrical Synapses

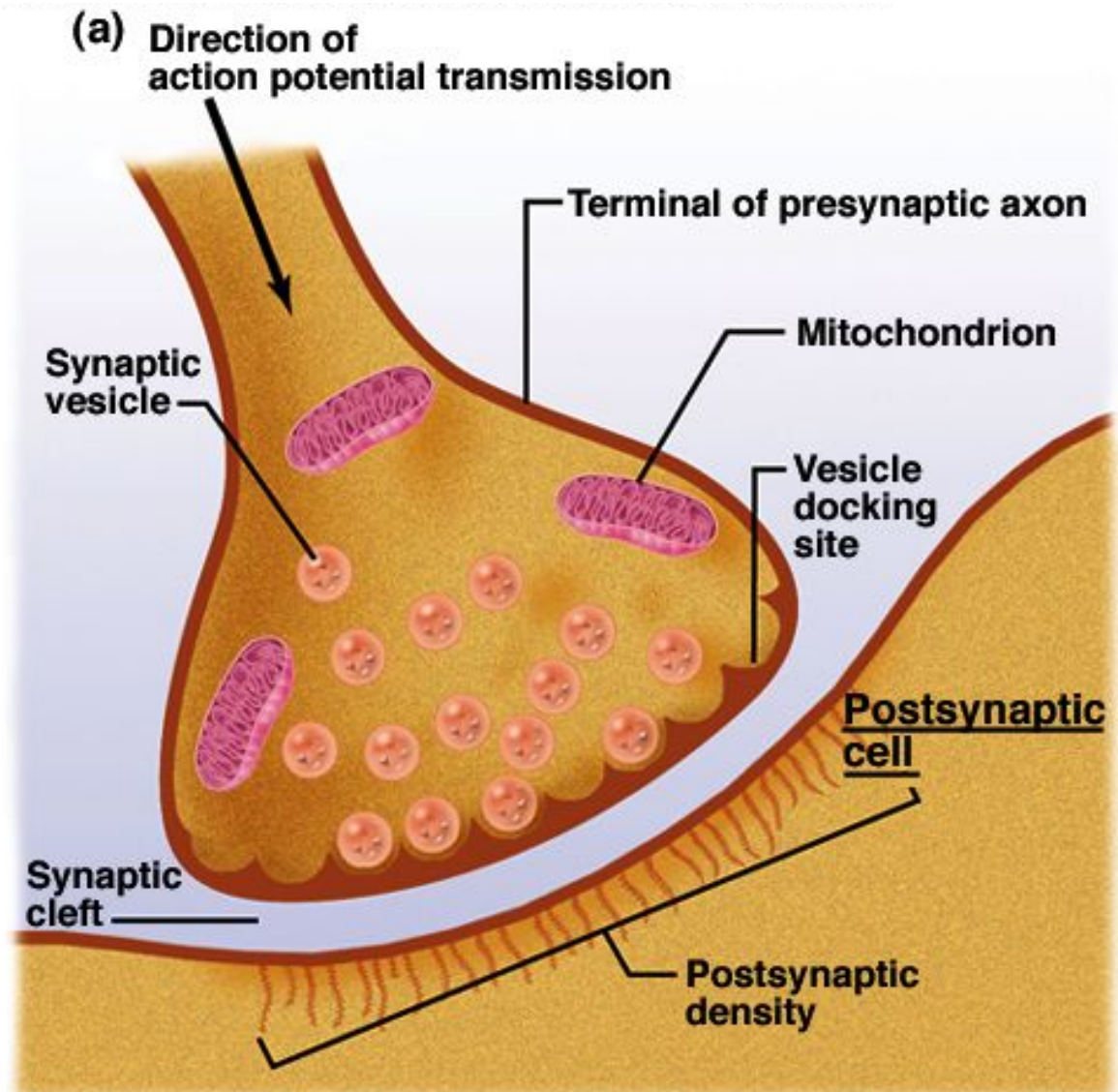
- Rapid bidirectional
- Gap junctions
- Ion current
- Electro tonic transmission
- Cytoplasmic continuity

Chemical Synapses

- unidirectional transmission
- Presynaptic vesicles, active zones, postsynaptic receptors
- Chemical neurotransmitters
- Complex amplifying excitatory/ inhibitory signals
- Synaptic cleft

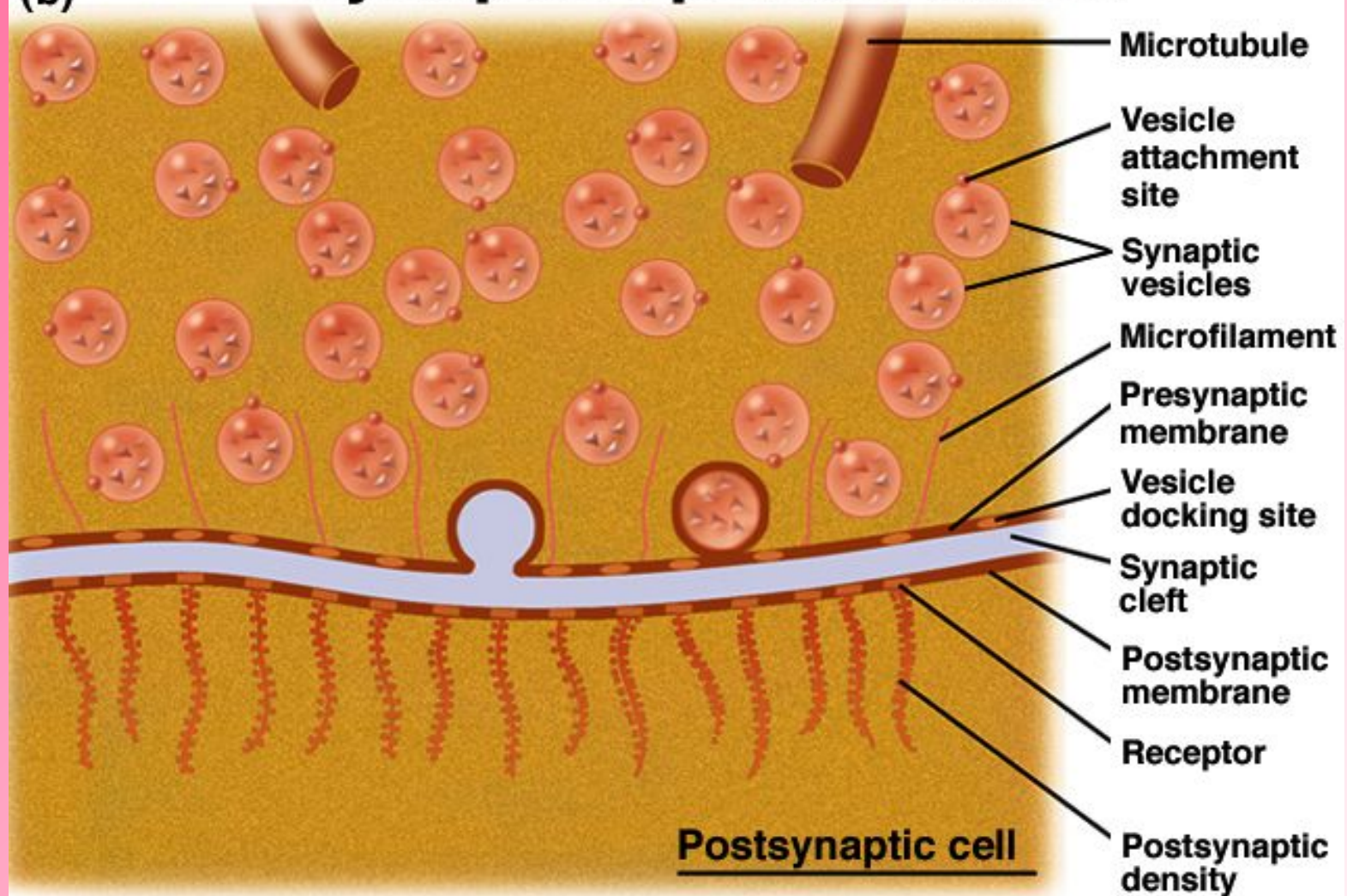


A synapse



Synaptic specialization

(b)



Structure of synapse

- Presynaptic terminal-round or oval knobs / boutons
 - Presynaptic vesicles (containing Neurotransmitters)
 - Mitochondria
 - Active zones/Dense bars
 - Voltage gated Ca^{++} channels
- Synaptic cleft:-20-30nm
- Postsynaptic membrane:-contains
 - Receptor proteins having
 - Binding component
 - Ionophore component
 - Ion channels
 - 2nd messenger activators

Small-Molecule, Rapidly Acting Transmitters

Class I

Acetylcholine

Class II: The Amines

Norepinephrine

Epinephrine

Dopamine

Serotonin

Histamine

Class III: Amino Acids

Gamma-aminobutyric acid (GABA)

Glycine

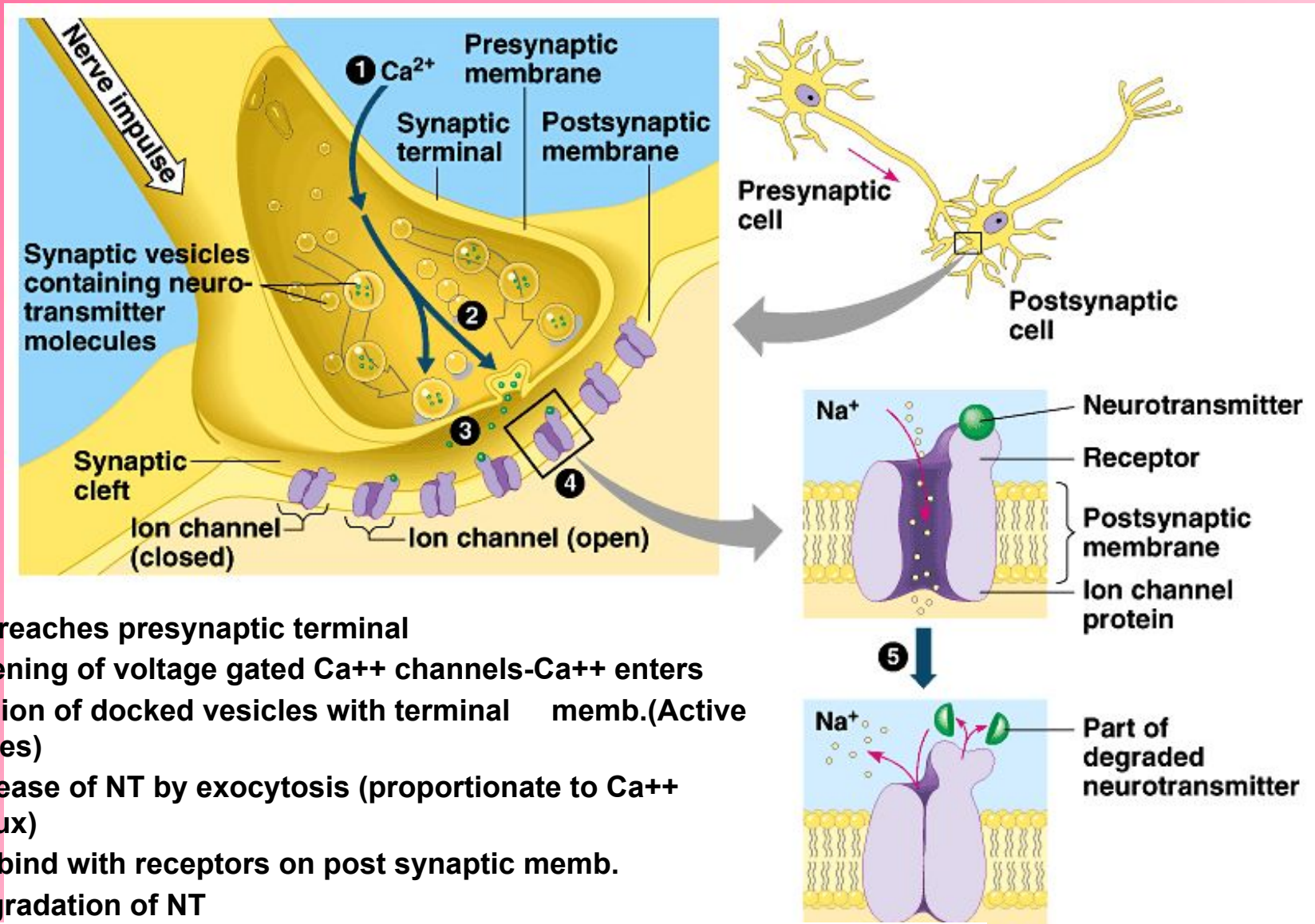
Glutamate

Aspartate

Class IV

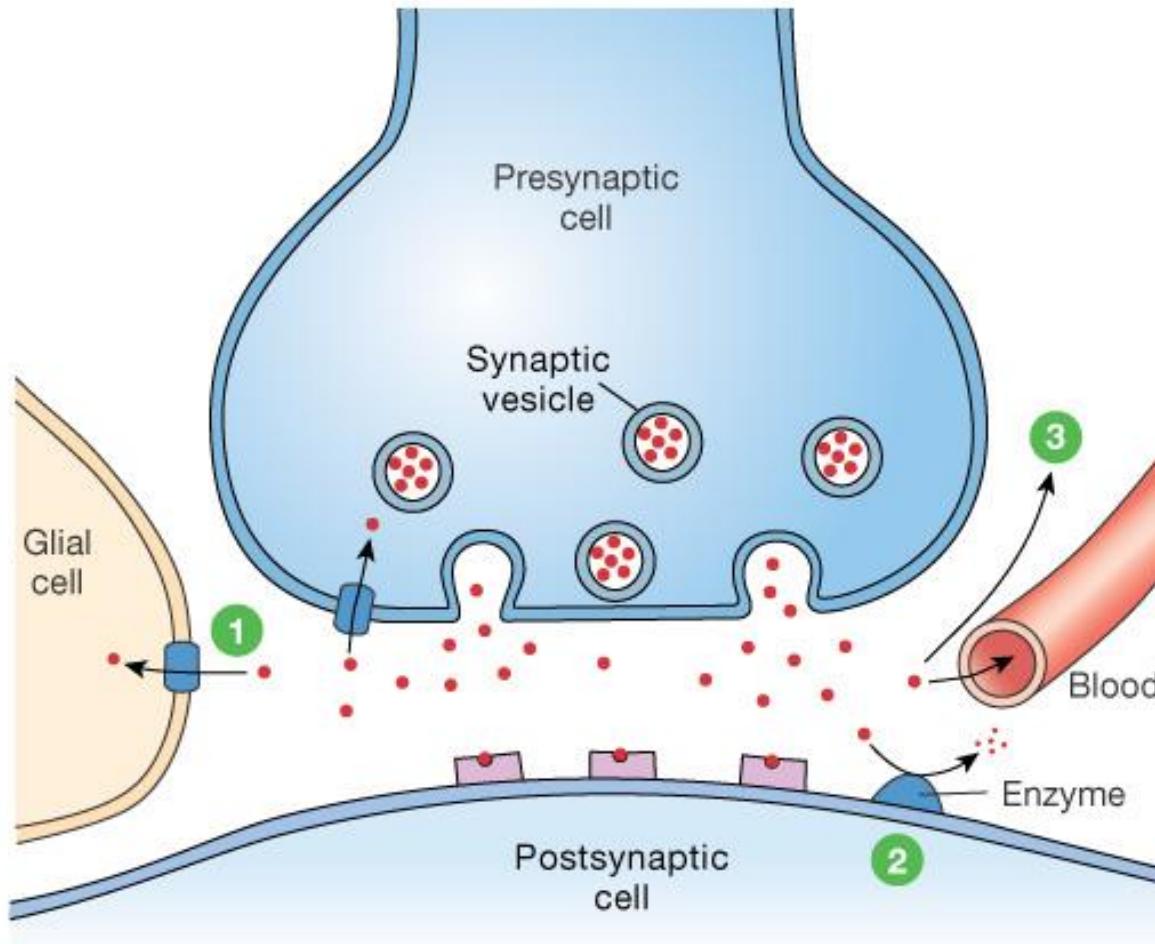
Nitric oxide (NO)

Release of Neurotransmitter



- AP reaches presynaptic terminal
- Opening of voltage gated Ca^{++} channels- Ca^{++} enters
- Fusion of docked vesicles with terminal memb.(Active zones)
- Release of NT by exocytosis (proportionate to Ca^{++} influx)
- NT bind with receptors on post synaptic memb.
- Degradation of NT

Inactivation of Neurotransmitters



- 1 Neurotransmitters can be returned to axon terminals for reuse or transported into glial cells.

e.g. Serotonin

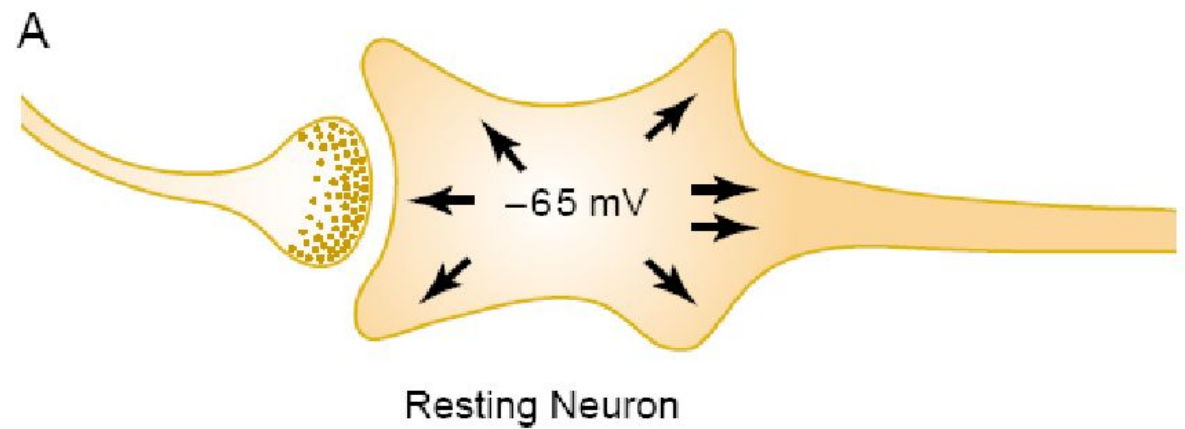
- 2 Enzymes inactivate neurotransmitters.

e.g. Ach

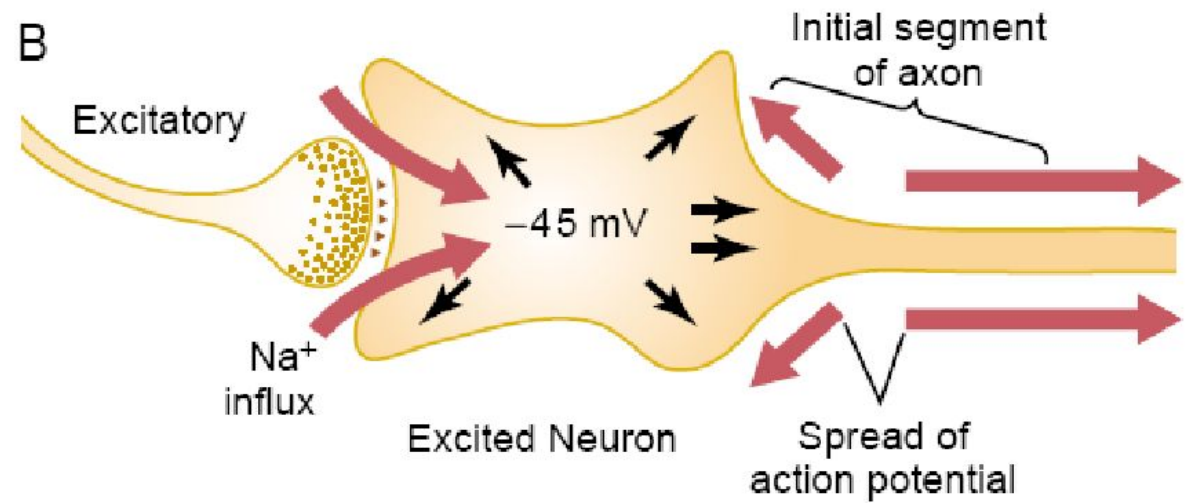
- 3 Neurotransmitters can diffuse out of the synaptic cleft.

e.g. NE

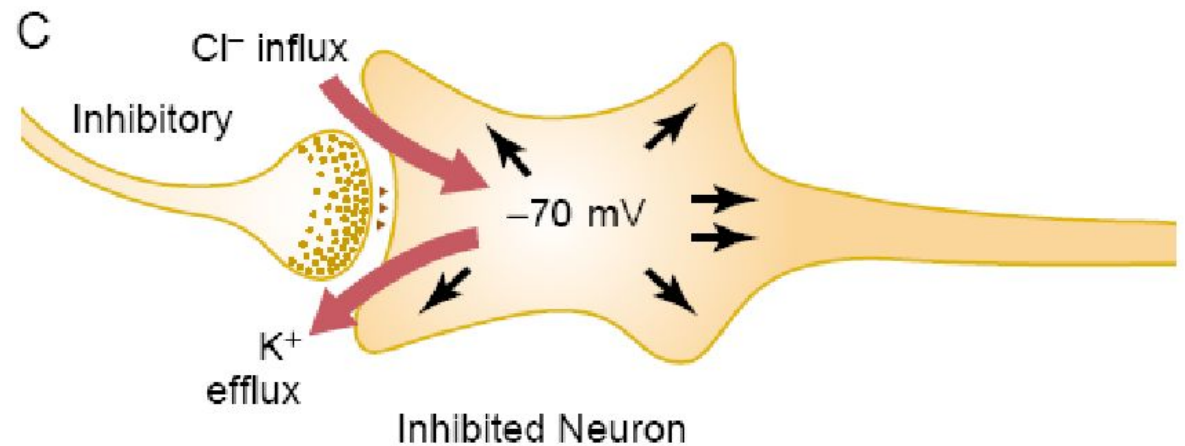
RMP



EPSP



IPSP



Excitatory post synaptic potential - EPSP

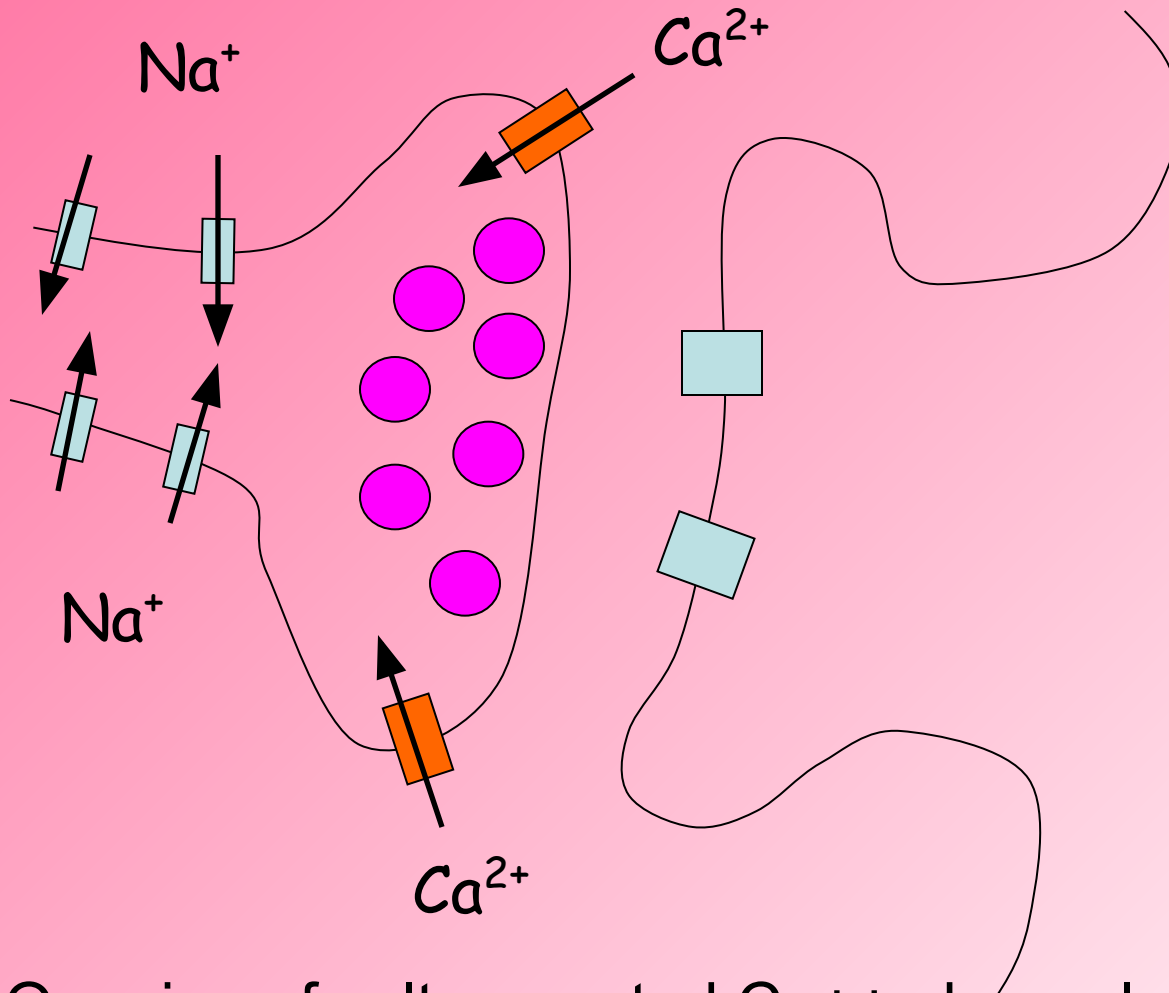
- Single stimulus can't produce AP
- During this excitability of other neuron to other stimulus is increased k/as EPSP
- It is a graded potential
- When reaches the threshold produces AP

- **Mechanism:-** Positivity inside
 - Opening of Na^+ channels –
 - Reduced conduction throu' K^+ & Cl^- Channels
 - Increase in excitatory receptors
 - Decrease in inhibitory receptors

Inhibitory post synaptic potential - IPSP

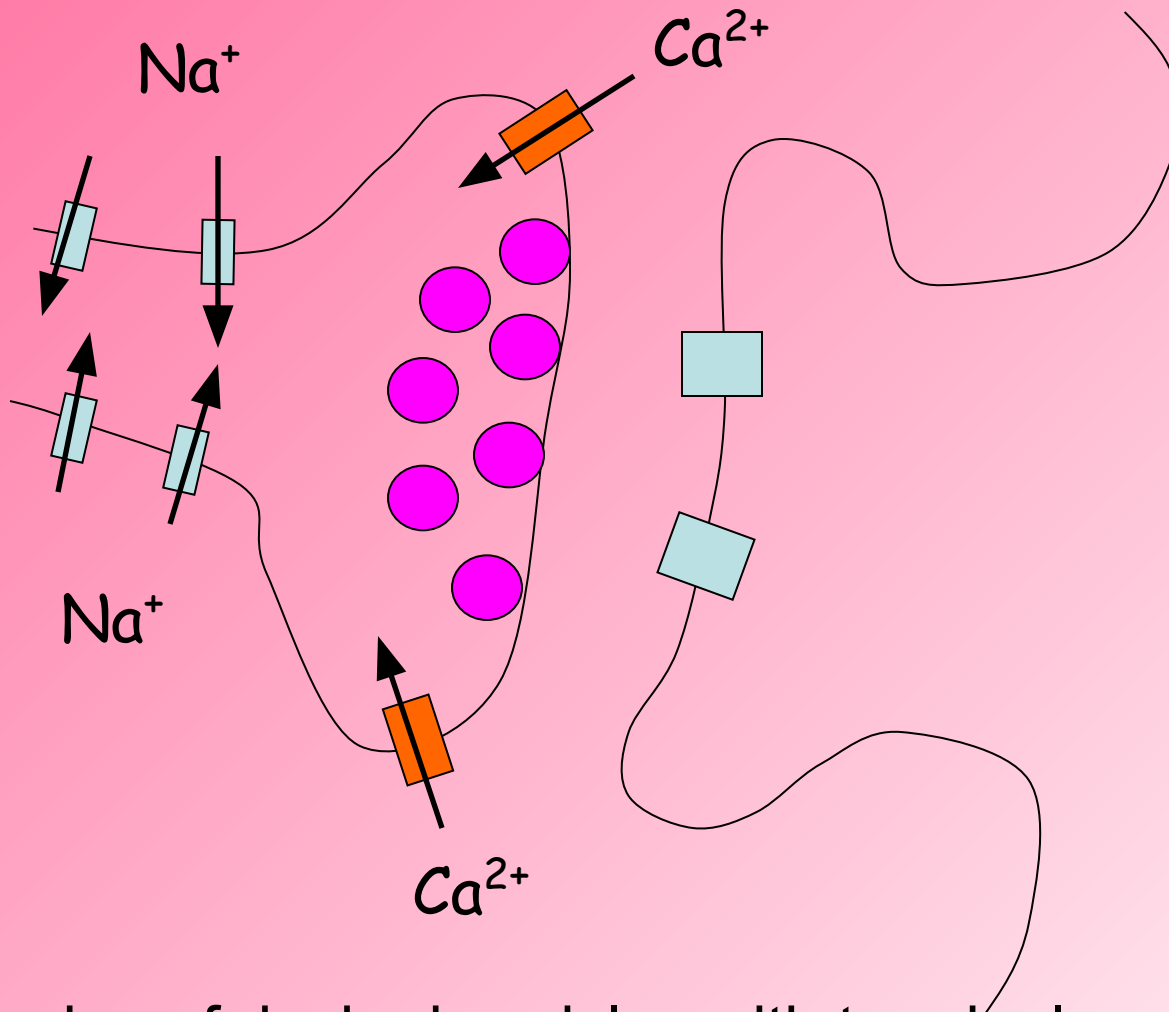
- It is hyperpolarizing graded potential
- Mechanism:-causes negativity inside
 - Opening of Cl^- channels – Influx
 - Increased conduction throu' K^+ Channels so efflux
 - Decrease in excitatory receptors
 - Increase in inhibitory receptors
 - Can also be produced by closure of Na^+ channels

Fast excitatory post synaptic potential (EPSP) transmission



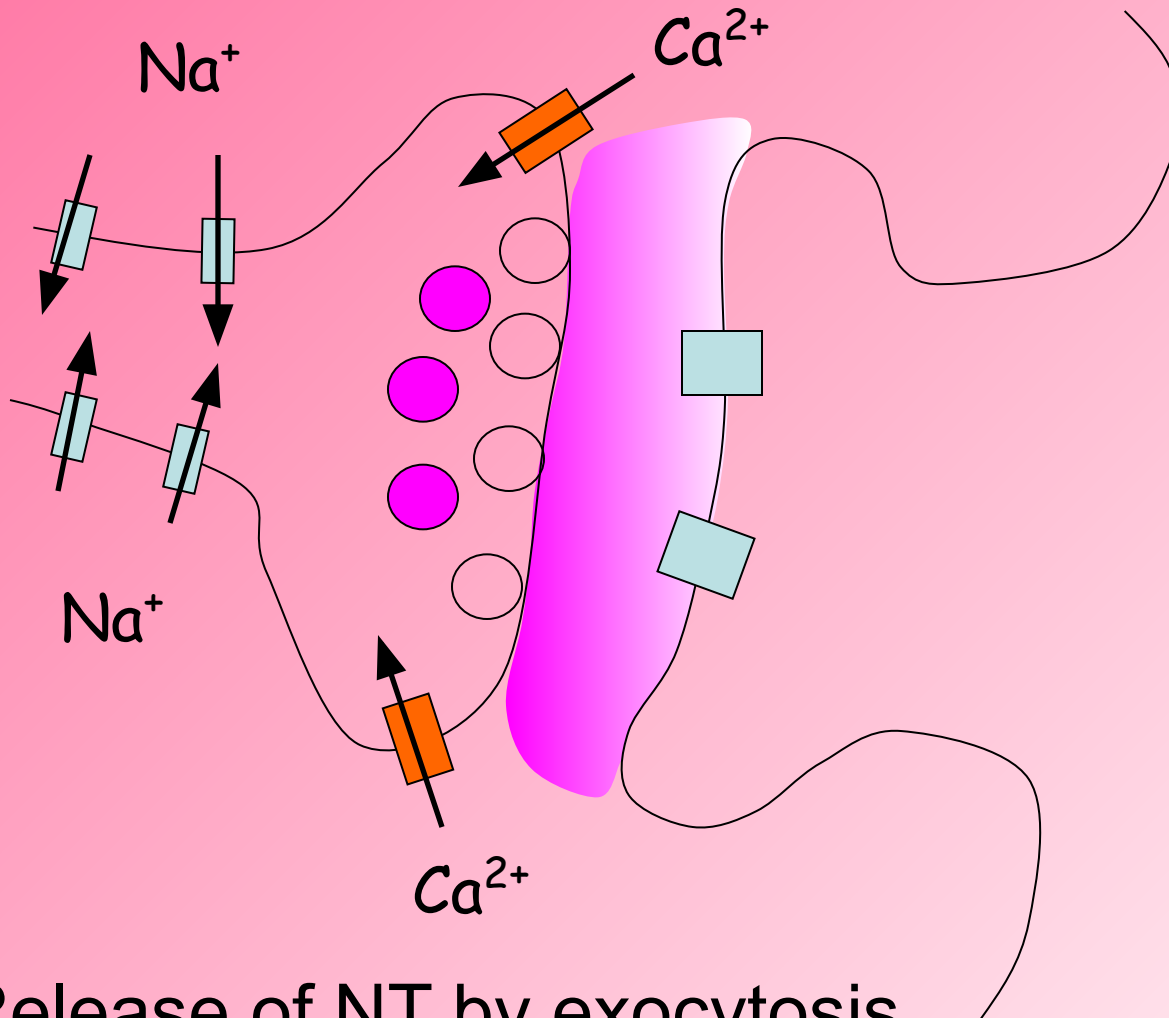
- Opening of voltage gated Ca^{++} channels- Ca^{++} enters

Fast excitatory post synaptic potential (EPSP) transmission



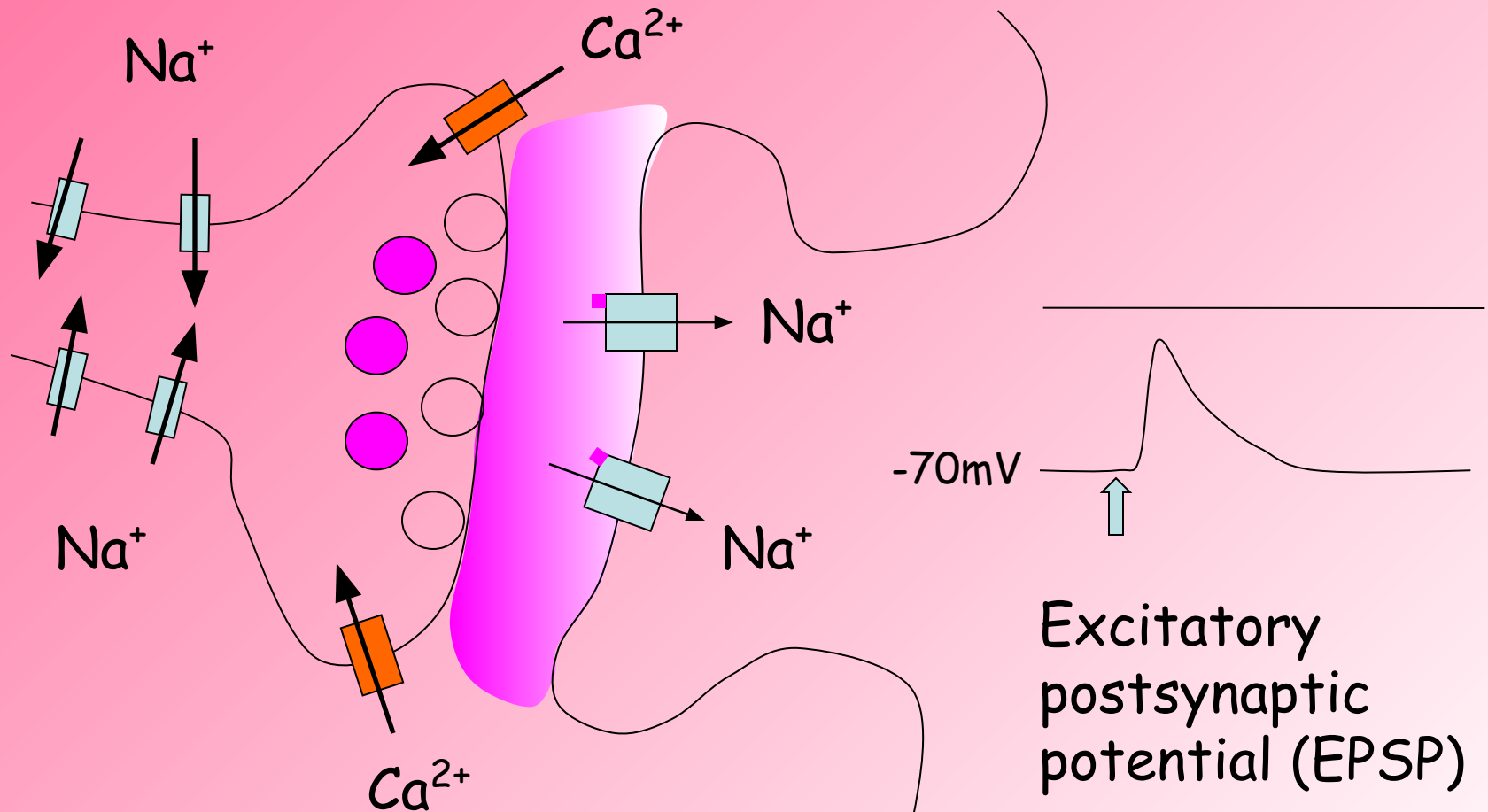
- Fusion of docked vesicles with terminal memb. (Active zones)

Fast excitatory post synaptic potential (EPSP) transmission



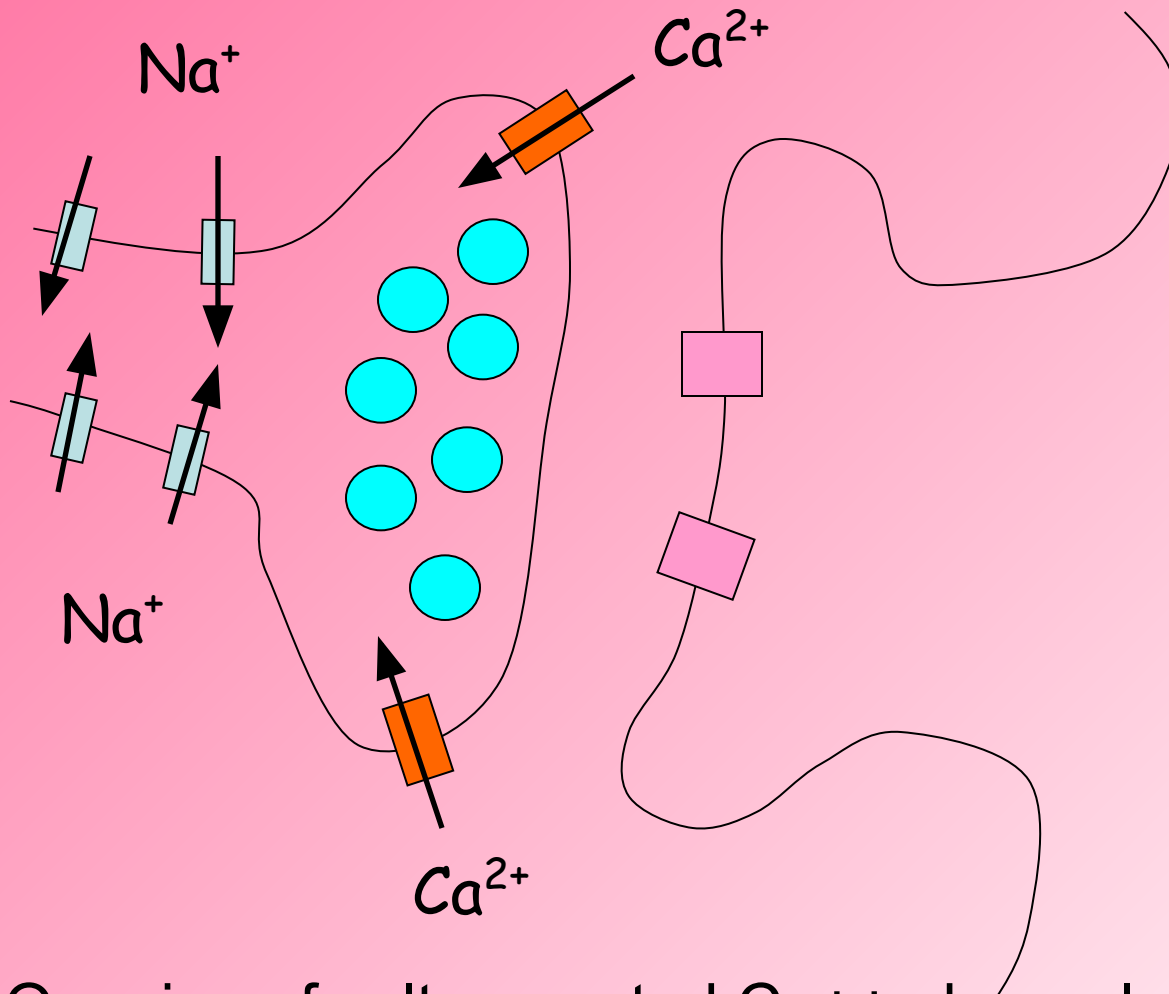
- Release of NT by exocytosis

Fast excitatory post synaptic potential (EPSP) transmission



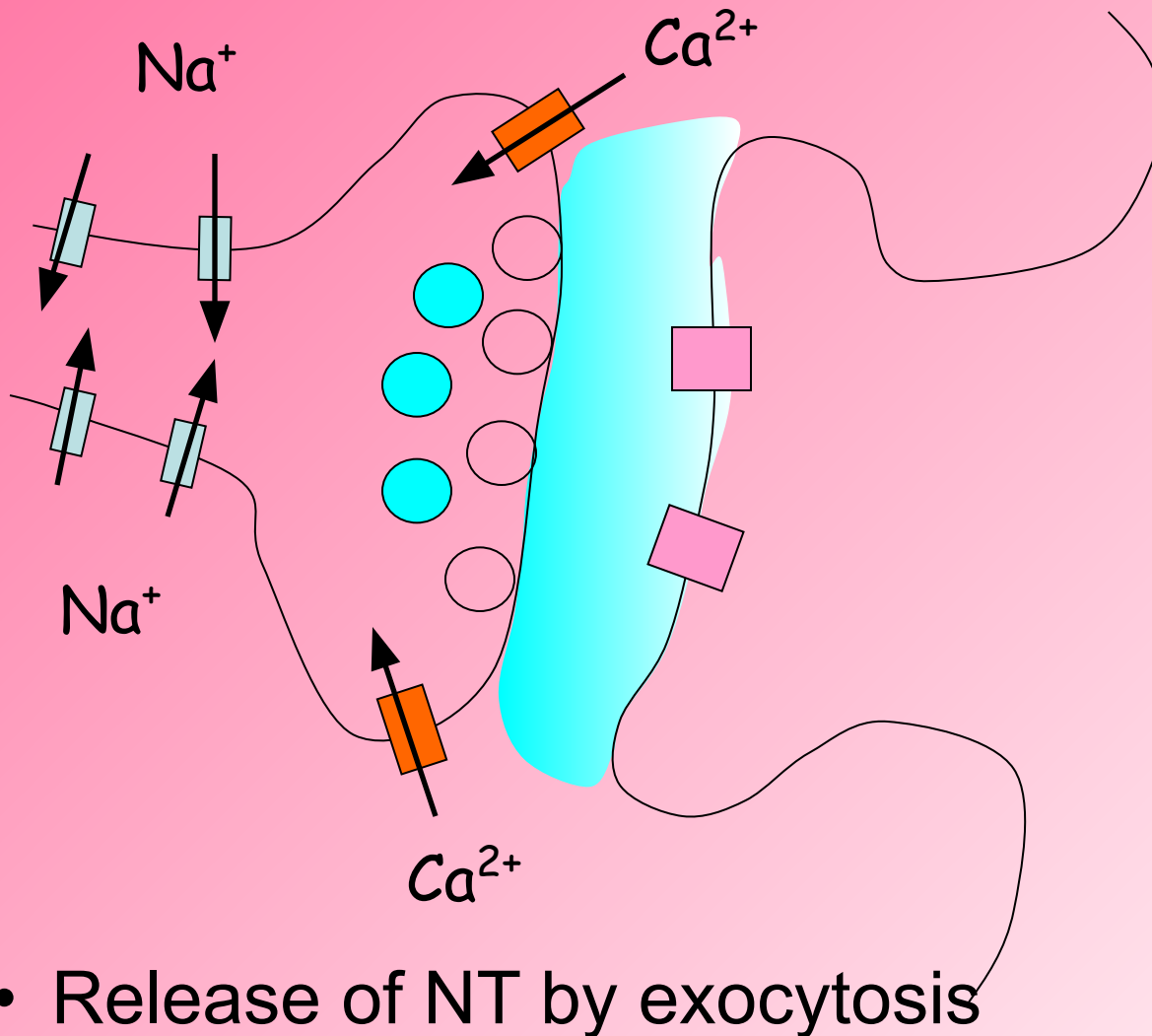
- NT bind with receptors on post synaptic memb - Opens Na^+ channels (Na^+ influx) – positivity inside

Fast transmission of inhibitory post synaptic potential (IPSP)

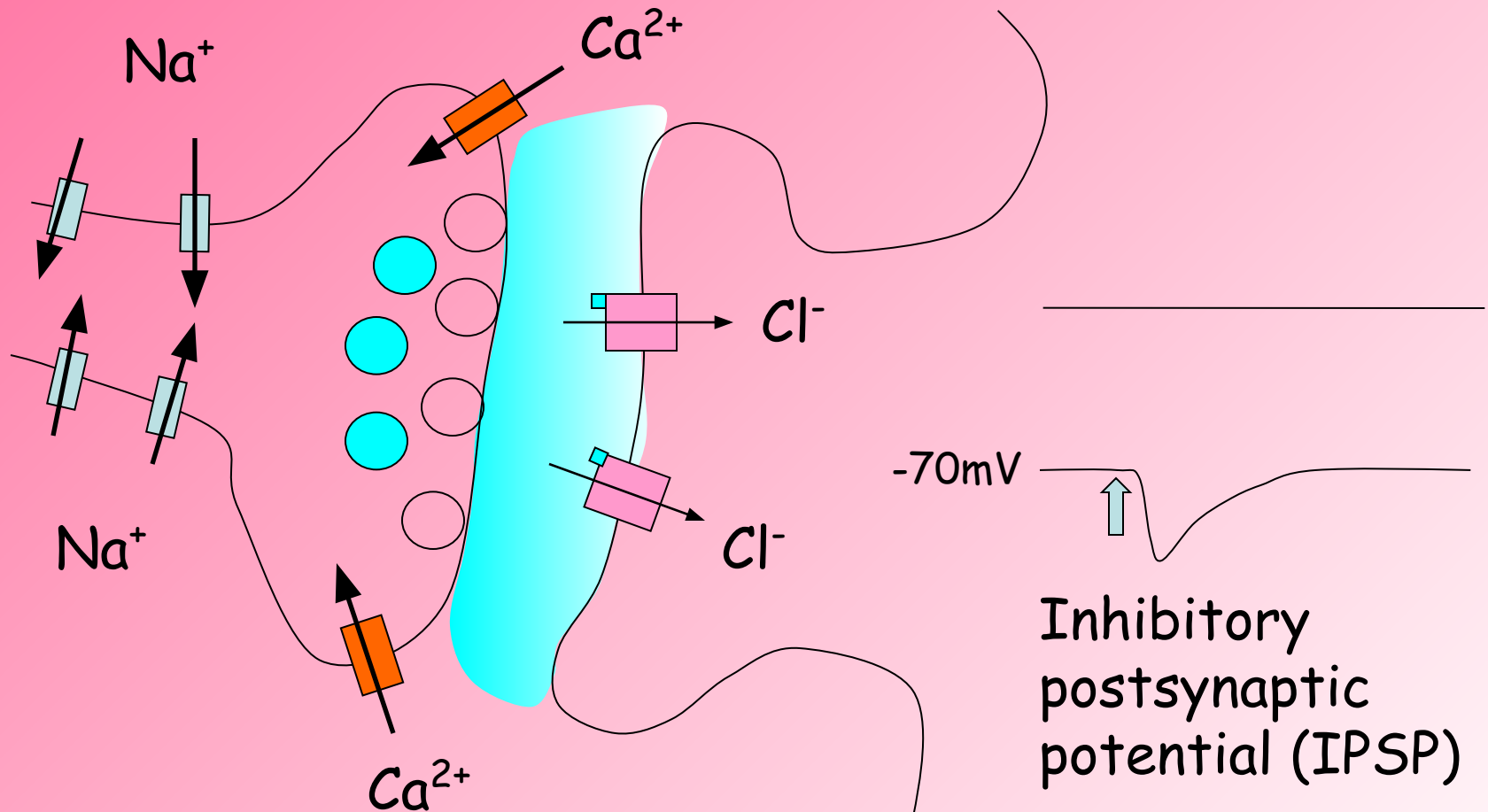


- Opening of voltage gated Ca^{++} channels- Ca^{++} enters

Fast transmission of inhibitory post synaptic potential (IPSP)

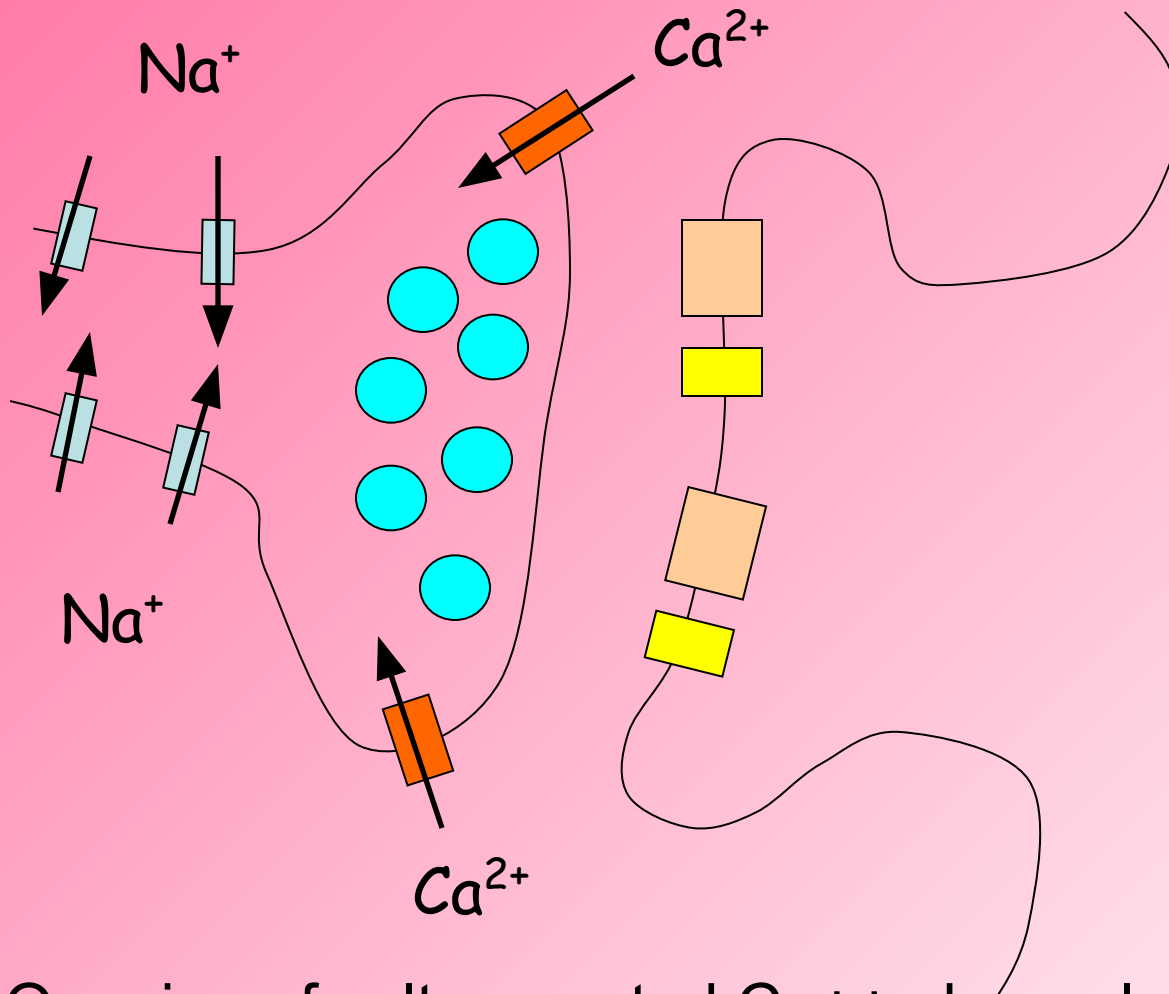


Fast transmission of inhibitory post synaptic potential (IPSP)



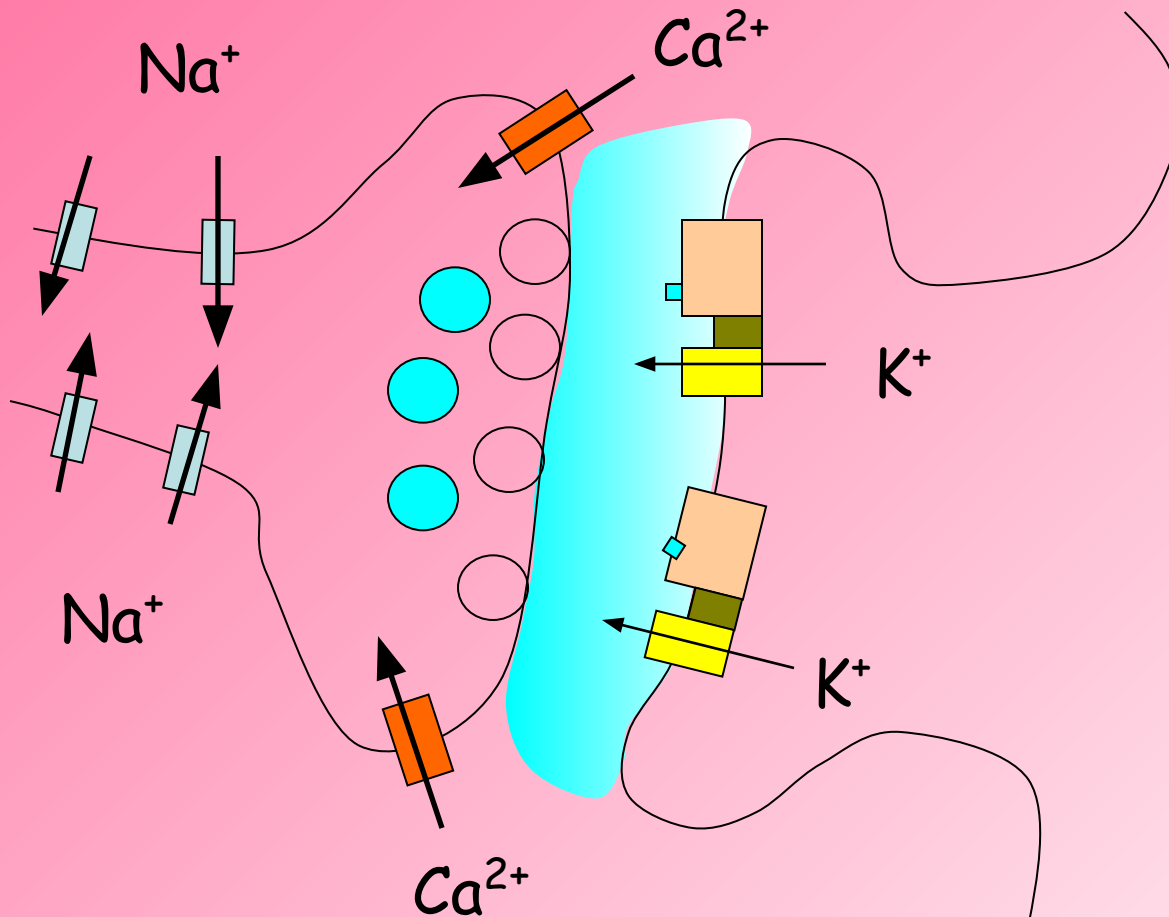
- NT bind with receptors on post synaptic memb –Opens Cl^- channels (Cl^- influx)-Negativity inside

Slow transmission of inhibitory post synaptic potential (IPSP)



- Opening of voltage gated Ca^{++} channels- Ca^{++} enters

Slow transmission of inhibitory post synaptic potential (IPSP)



- NT bind with receptors on post synaptic memb
–Opens K⁺ channels (K⁺ efflux)

Properties of postsynaptic potentials

- Mediated by ligand-gated channels
- Graded
- Decremental (ie local, non-propagated)
- Depolarising (excitatory) or hyperpolarizing (inhibitory)
- Can summate
- Enable synaptic integration

Assignment

- Define and classify synapse
- What is EPSP and IPSP ?

Thank you