KING'S College LONDON

INSTITUTE OF PSYCHIATRY,
PSYCHOLOGY & NEUROSCIENCE

Module:
Biological Foundations of Mental Health

Week 3:
Synaptic transmission and neurotransmitter systems

Dr Phil Holland

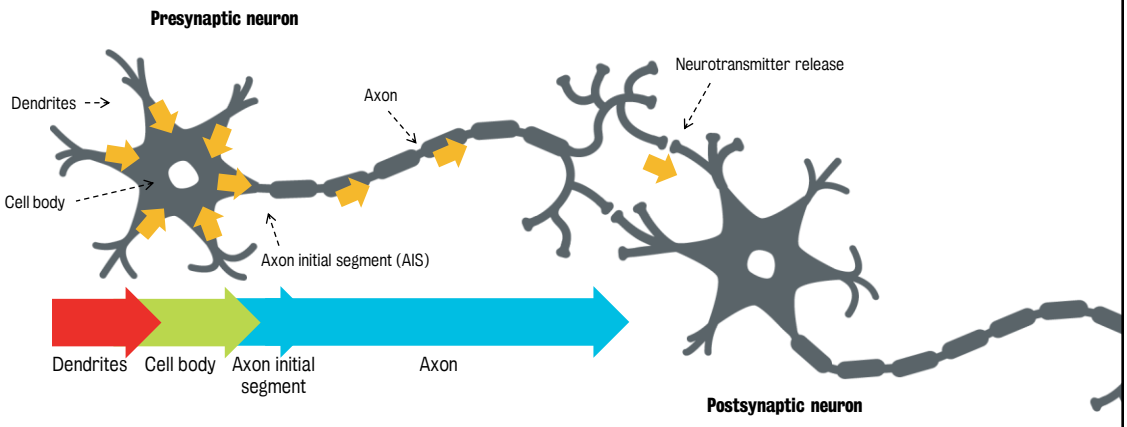
Topic 1:

Action potentials and Synaptic transmission

Part 5 of 5

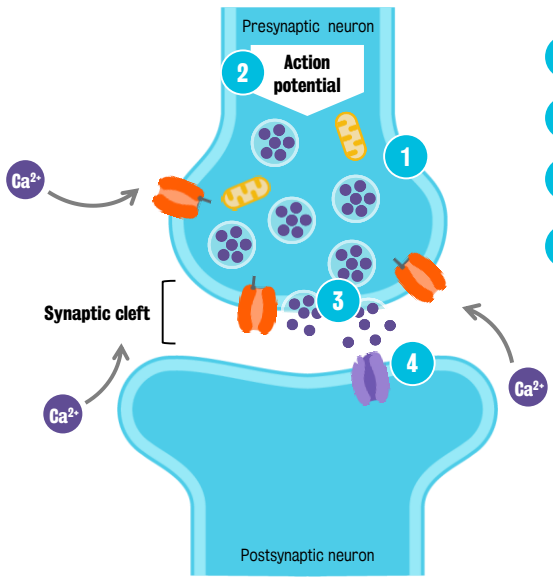
Part 5

Synaptic transmission in chemical synapses (1)



Synaptic transmission in chemical synapses (2)

Calcium has a much higher concentration in the extracellular space than the intracellular space.

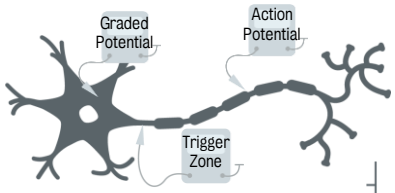


1. Resting synapse
2. Action potential arrives, voltage-gated Ca^{2+} channels open
3. Ca^{2+} entry triggers exocytosis of synaptic vesicle content
4. Neurotransmitter diffuses across the synaptic cleft and activates ligand gated ion channels in the postsynaptic cell membrane

- Voltage-gated calcium channels
- Mitochondria
- Vesicles (circle) and neurotransmitters (small dots)
- Ca^{2+} Calcium
- Ligand-gated ion channel

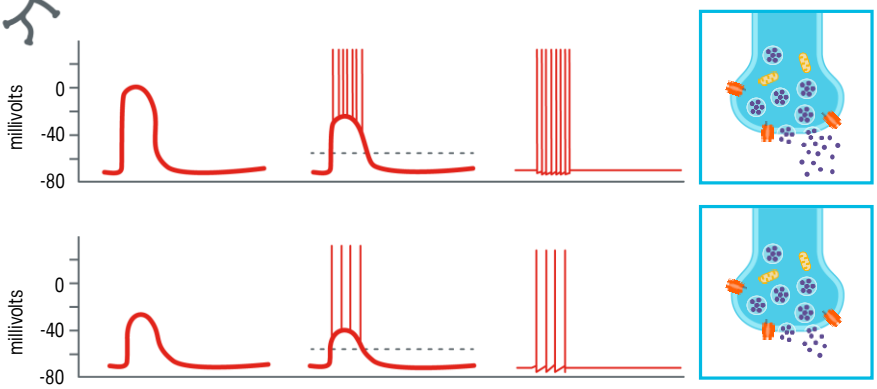
Exocytosis:
Ca^{2+} entry triggers exocytosis of synaptic vesicle content

Stimulus dependent neurotransmitter release

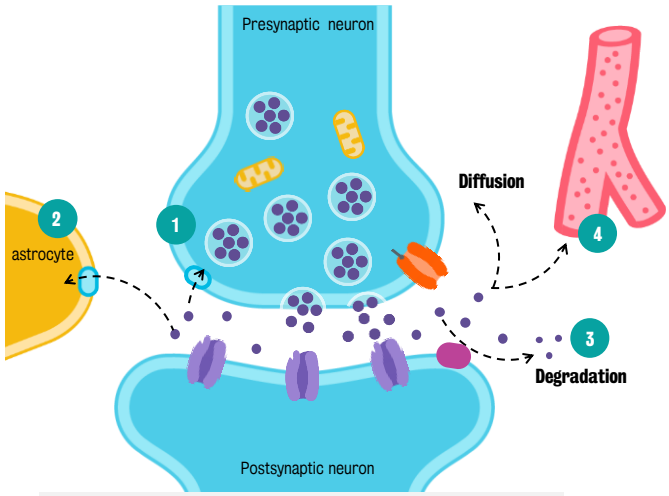


The firing mechanism between the presynaptic and postsynaptic cell is stimulus-dependent.

Recording electrodes:
We're recording the graded potential that's coming into the cell body, what's happening at the axon initial segment triggering zone, and the action potentials from the axon.



Neurotransmitter removal

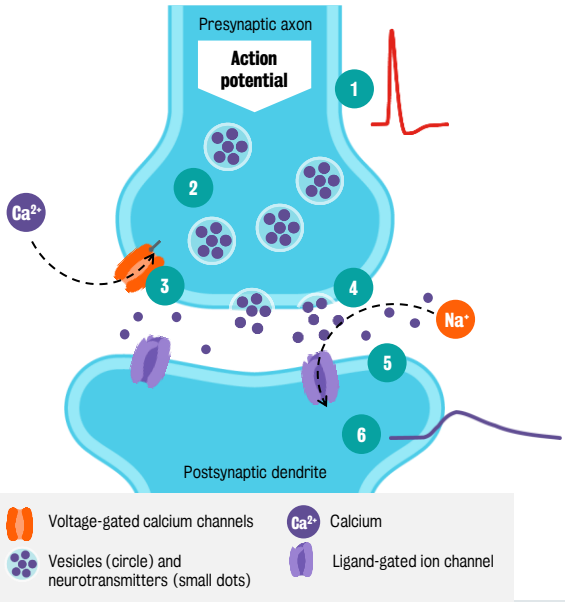


There are several mechanisms that deal with the removal of neurotransmitters:

1. Reuptake of the neurotransmitters into the presynaptic cell
2. Reuptake of the neurotransmitters by the supporting glial cells (e.g. astrocytes)
3. Degrading of neurotransmitters on the postsynaptic membrane
4. Diffusion of neurotransmitters away from the synaptic cleft and taken up into the bloodstream

Antidepressant that act as serotonin reuptake inhibitors prevent the reuptake of serotonin, potentiating the effect of its normal release

The synaptic transmission: Graded potentials



1. Incoming action potential
2. Action potential triggers a voltage change at the presynaptic terminal
3. Voltage-gated calcium channels open and positively charged calcium floods in to the presynaptic terminal
4. This triggers vesicle exocytosis
5. Postsynaptic ion channels are activated and this allows sodium to flux into the postsynaptic dendrite
6. Triggering of an excitatory postsynaptic potential (due to sodium's depolarising effect)

End of topic