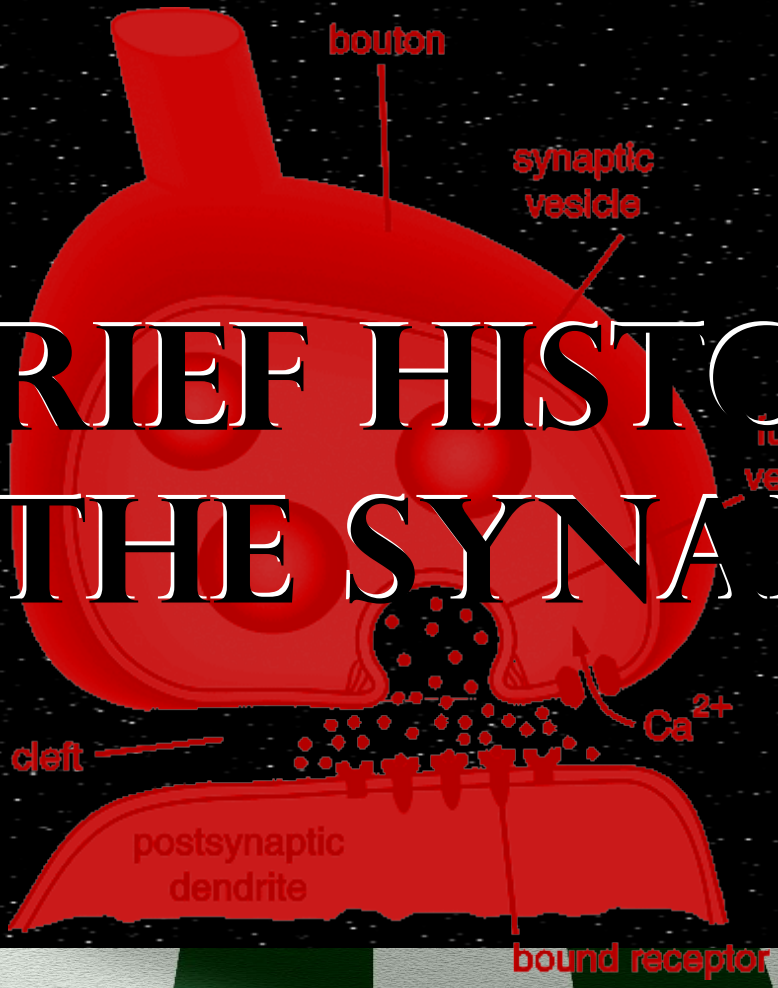
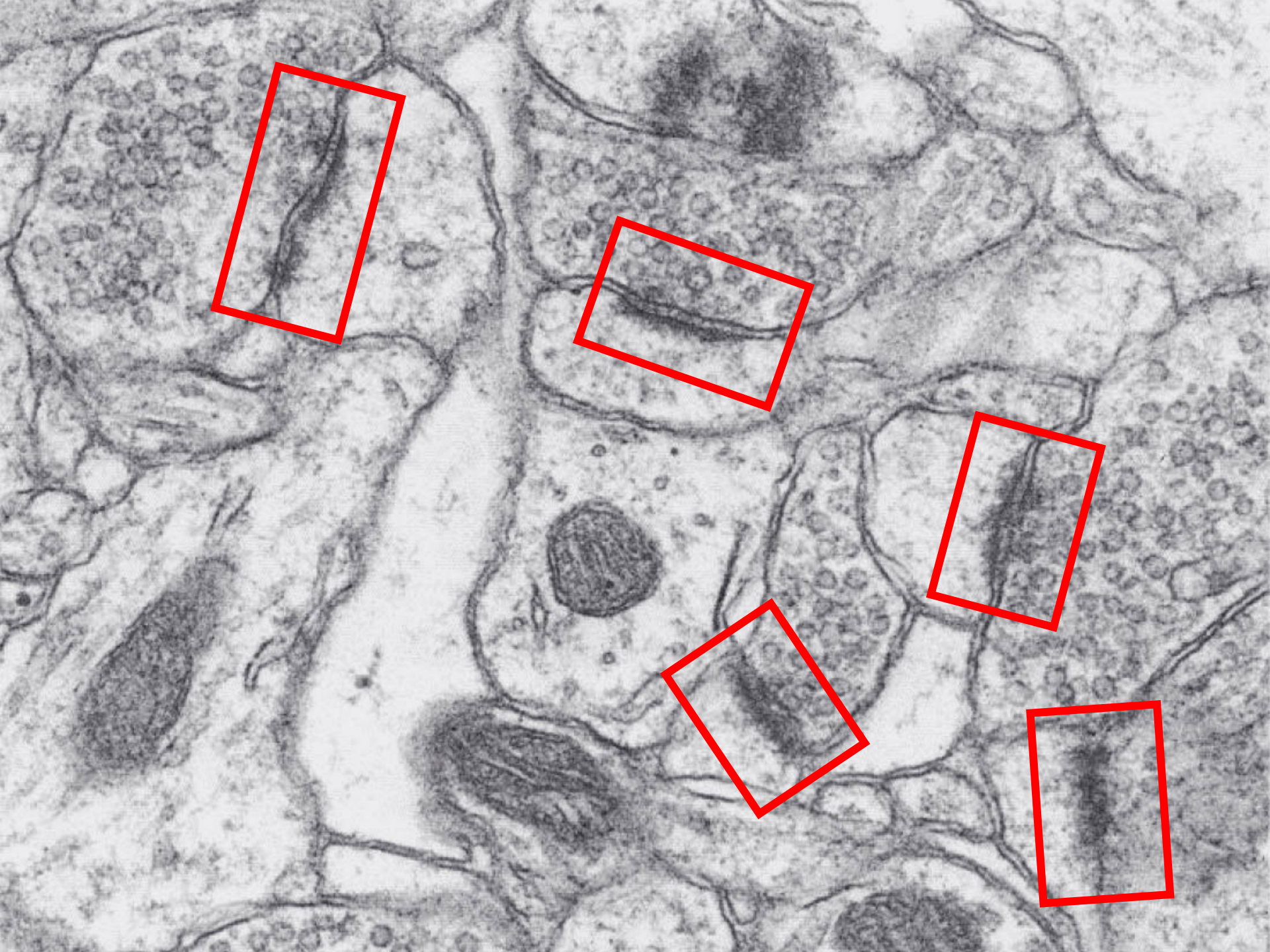
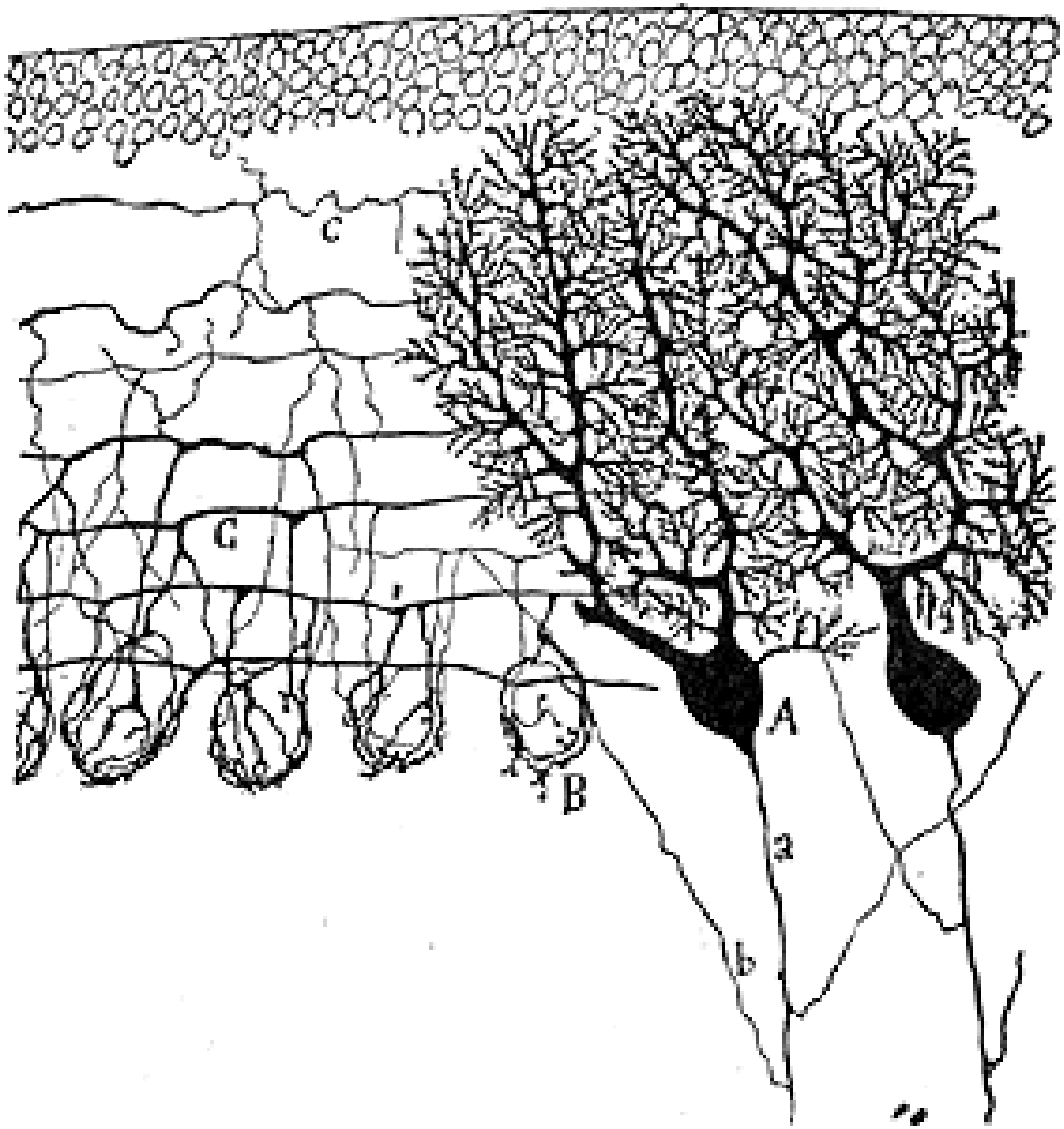
A BRIEF HISTORY OF THE SYNAPSE



DAVID SANTUCCI
QUANTITATIVE BIOLOGY BOOTCAMP 2009



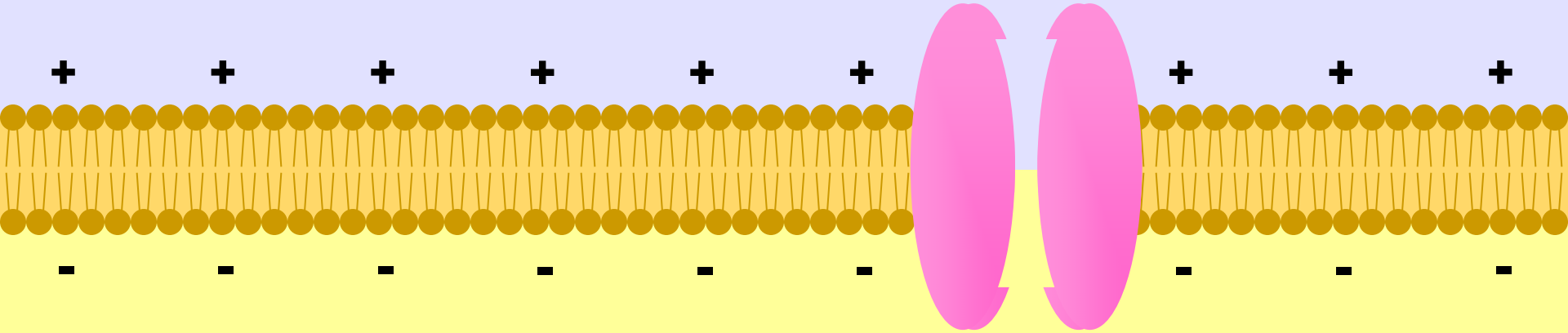
Santiago Ramón y Cajal



Drawing of Chick Cerebellum

Extracellular Space

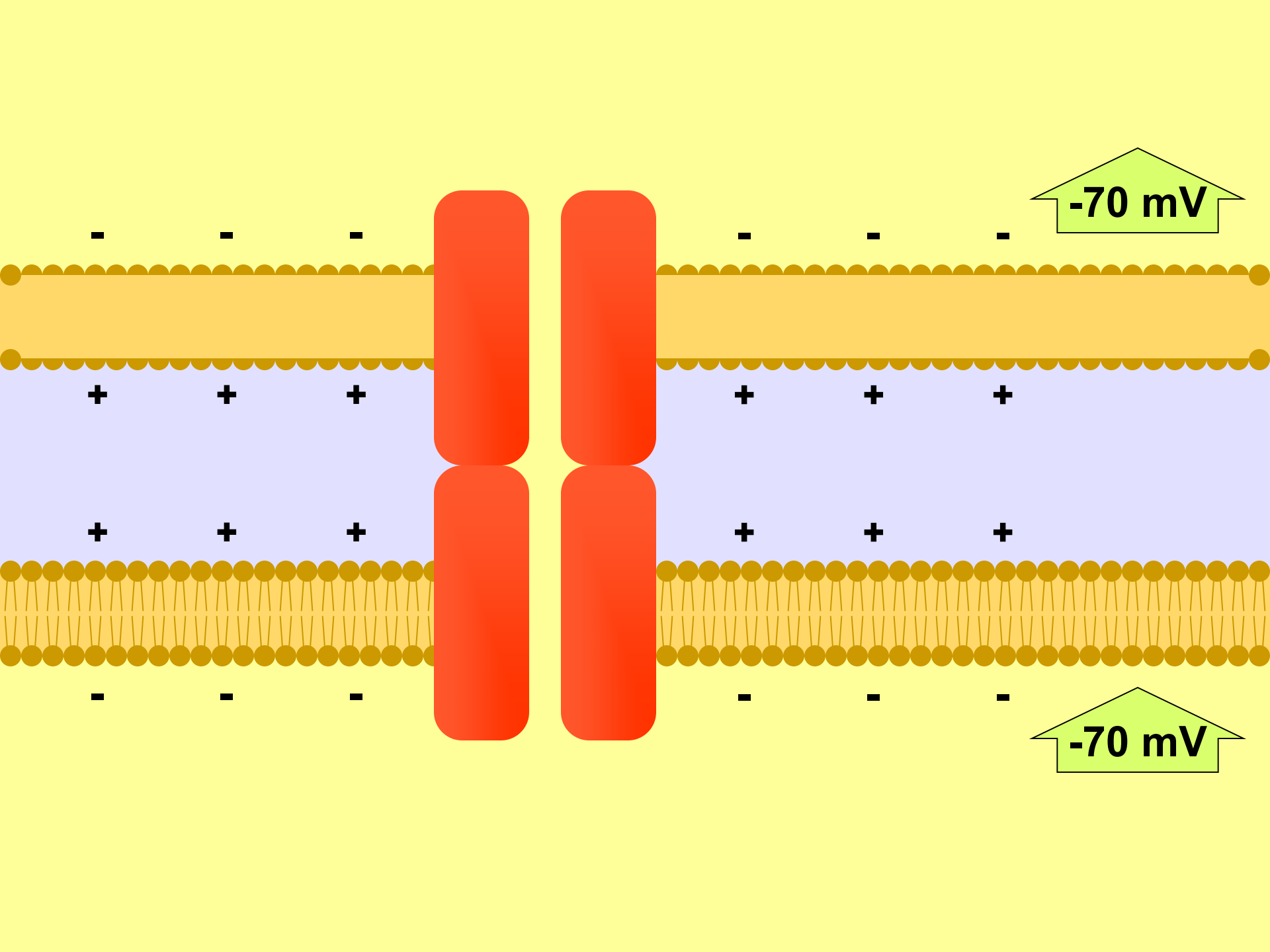
Na^+ K^+ Cl^- Ca^{2+}

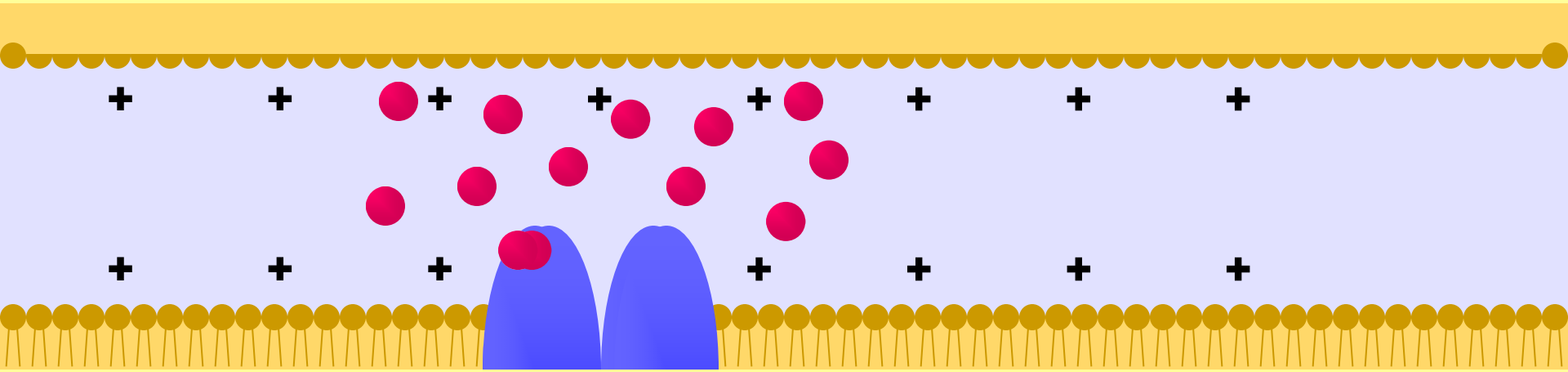


-70 mV

Na^+ K^+ Cl^- Ca^{2+}

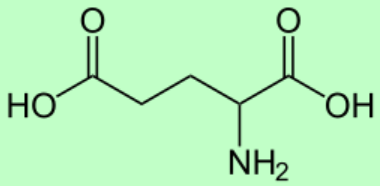
Intracellular Space


-70 mV
-70 mV



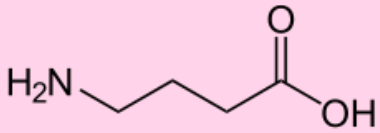
Neurotransmitters

Excitatory



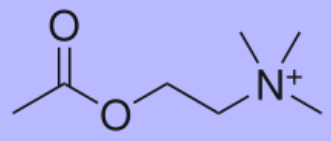
Glutamate

Inhibitory

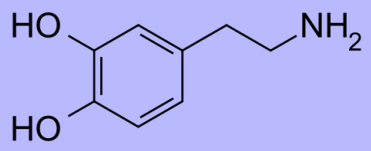


GABA

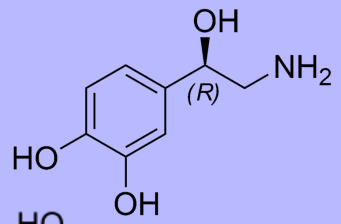
Modulatory



Acetylcholine

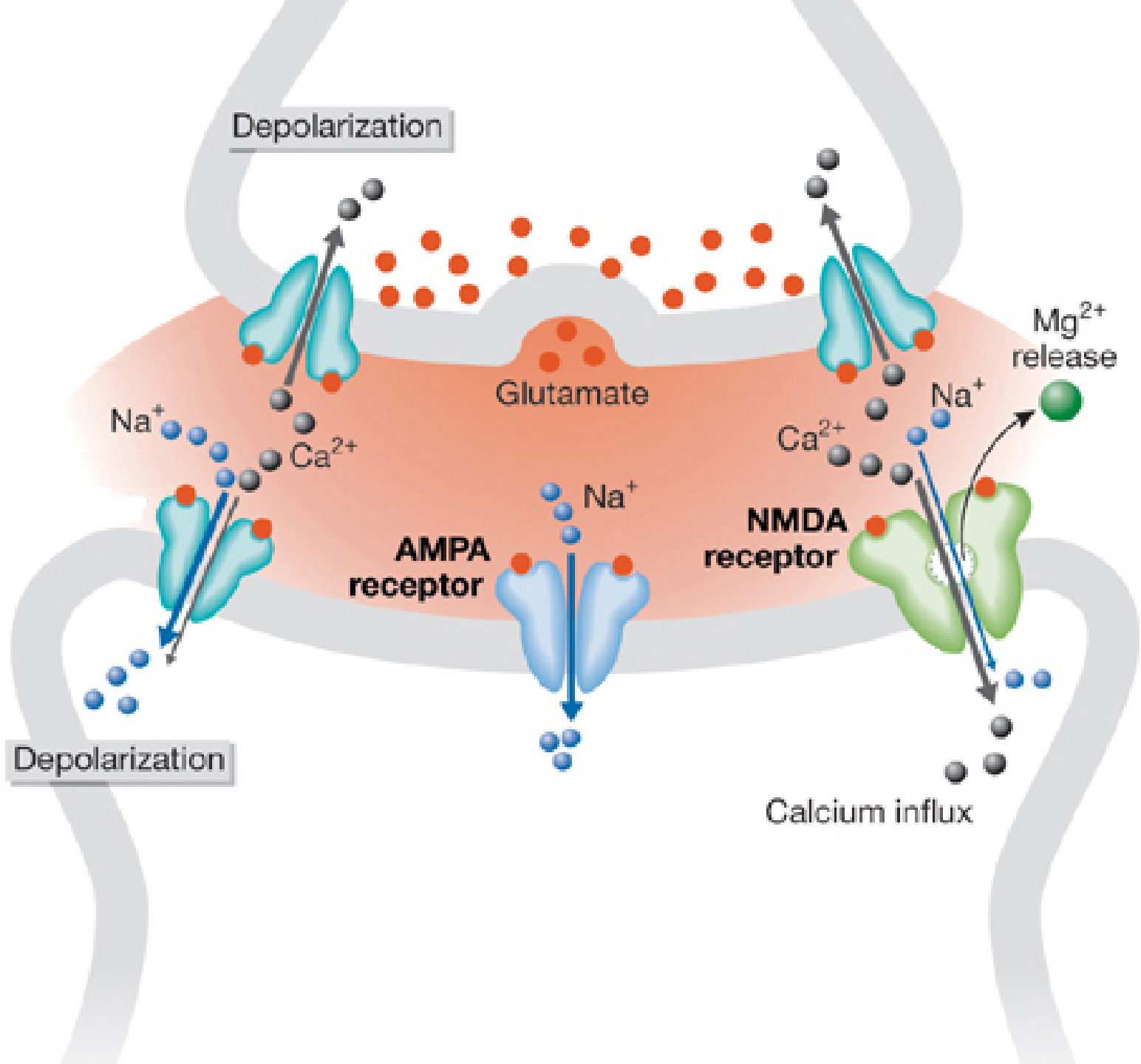


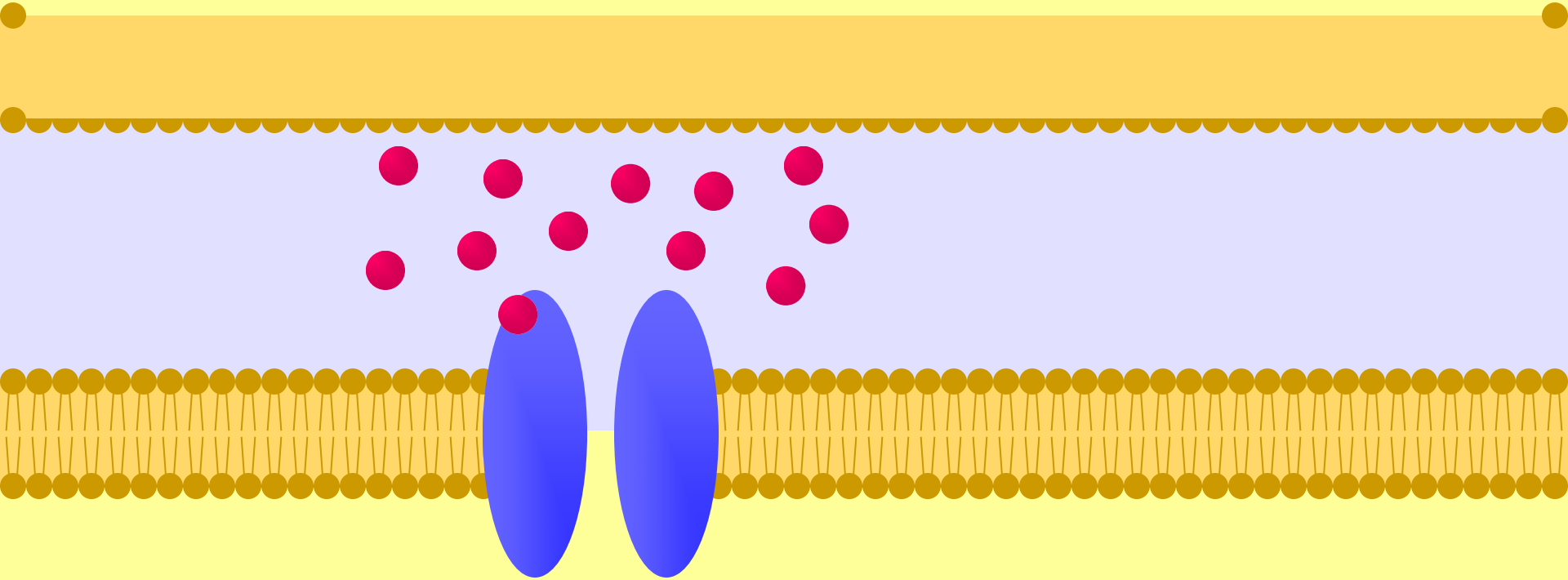
Dopamine



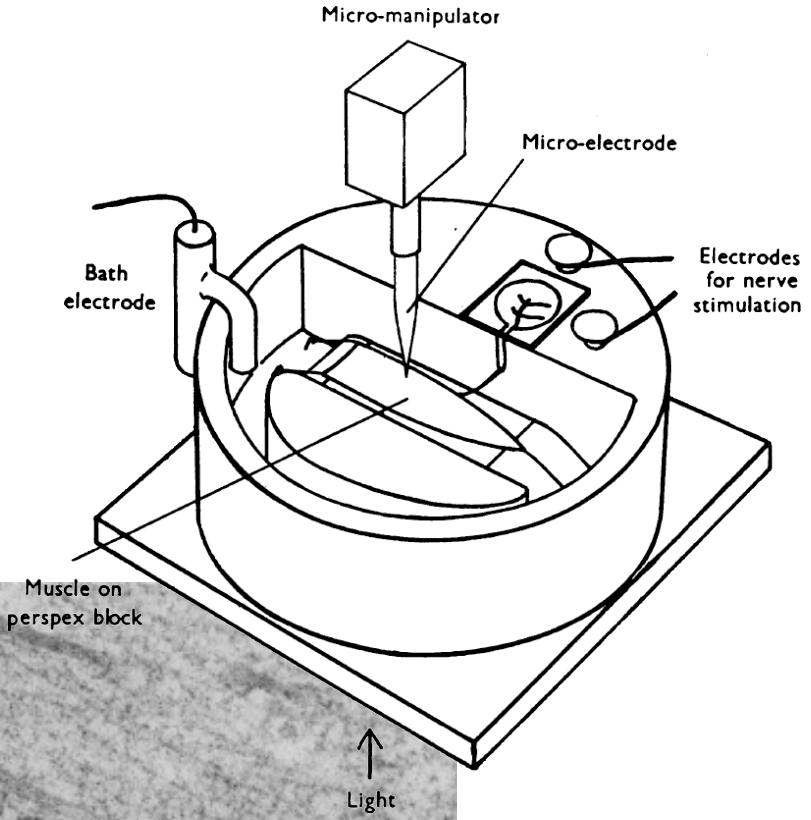
Norepinephrine

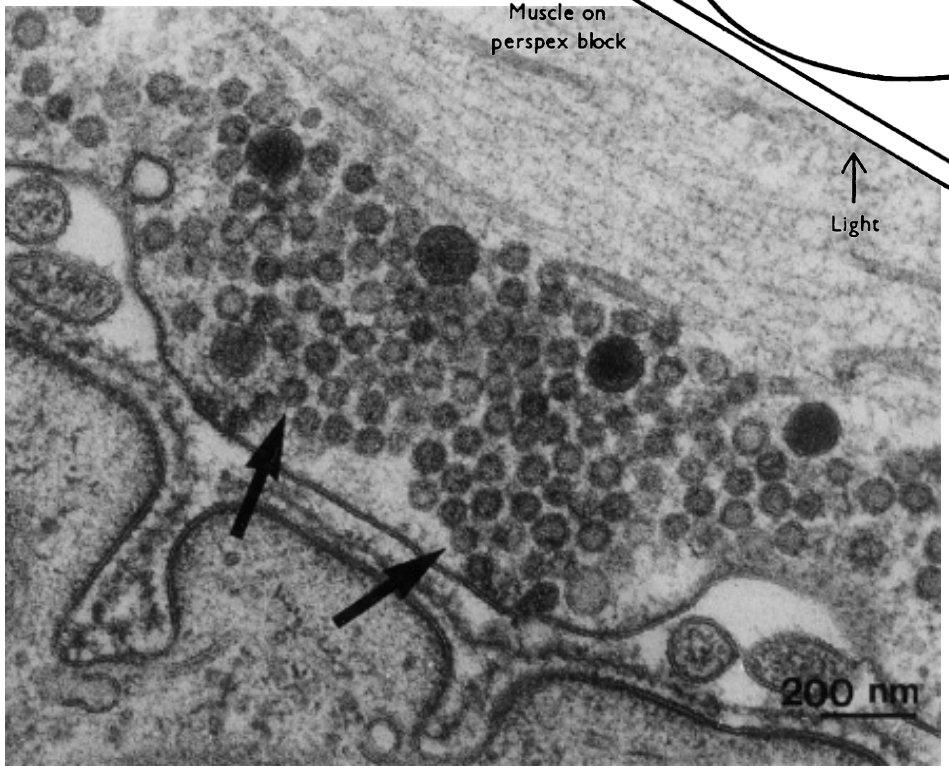
Serotonin


Depolarization
Glutamate
Mg^{2+} release
Na^+
Ca^{2+}
Na^+
Ca^{2+}
Na^+
AMPA receptor
NMDA receptor
Depolarization
Calcium influx



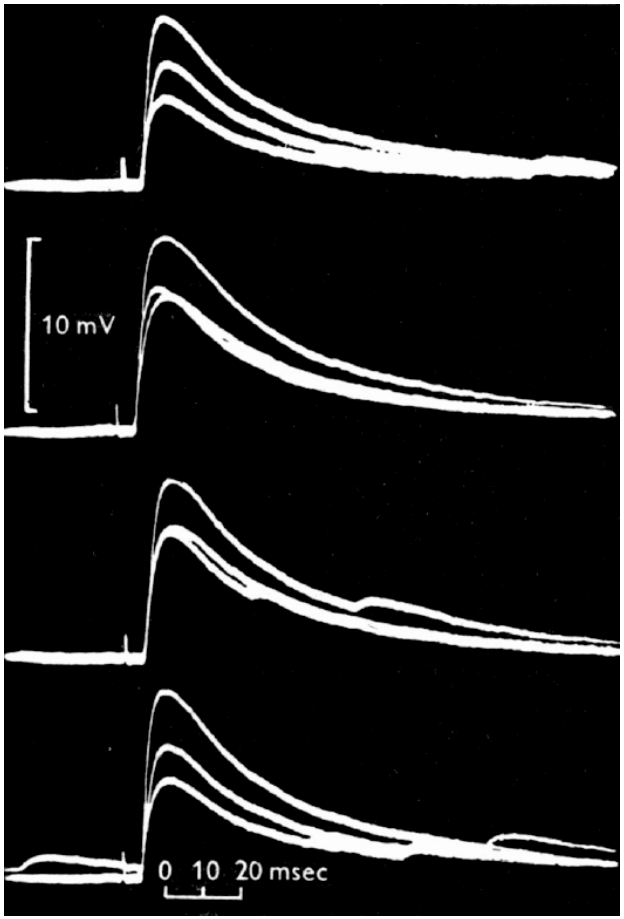
Bernard Katz



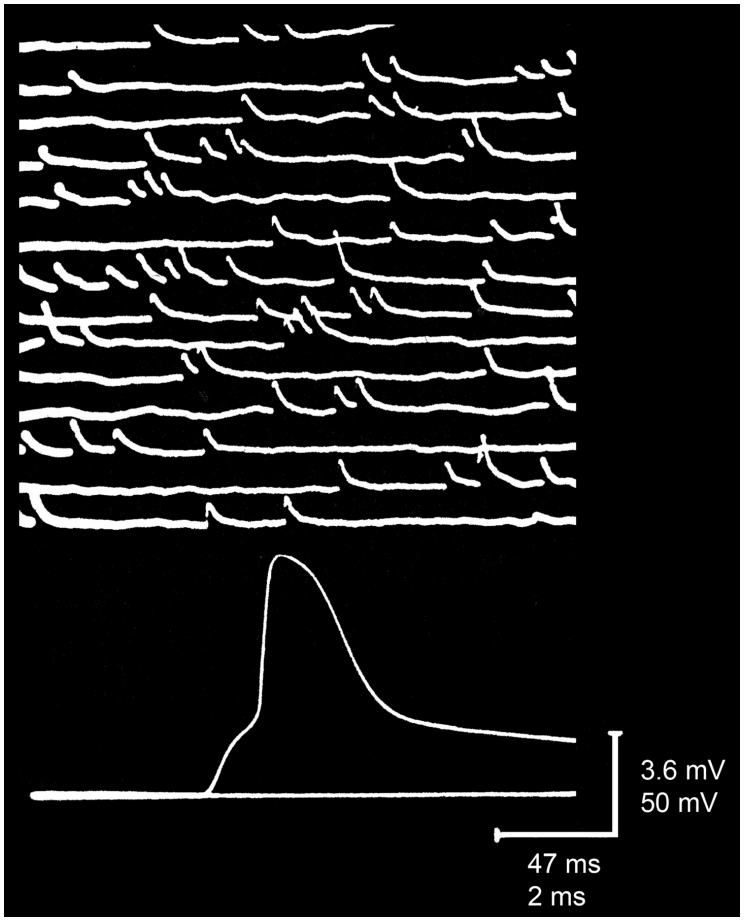


Frog Neuromuscular Junction (NMJ)

Bernard Katz

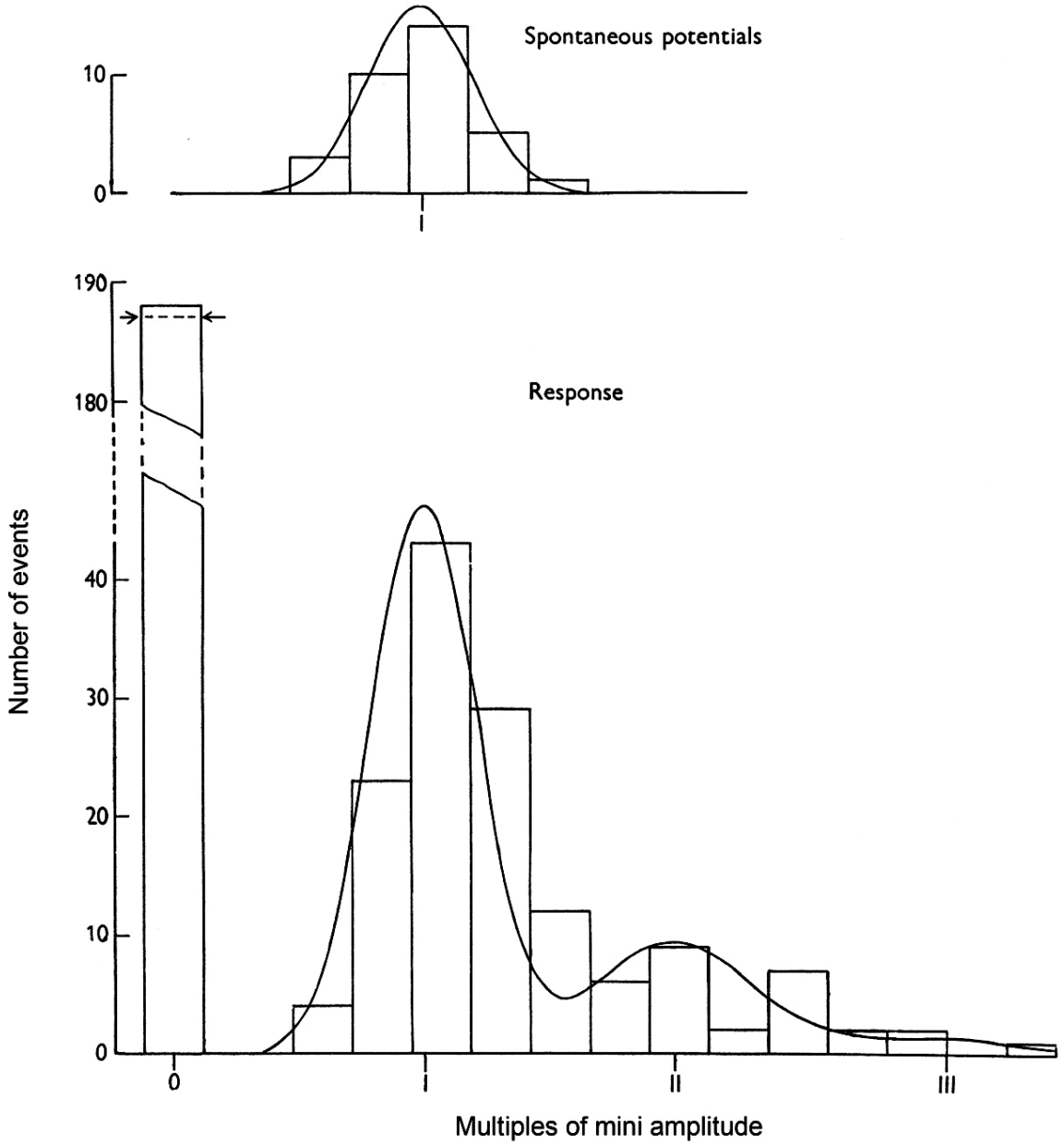


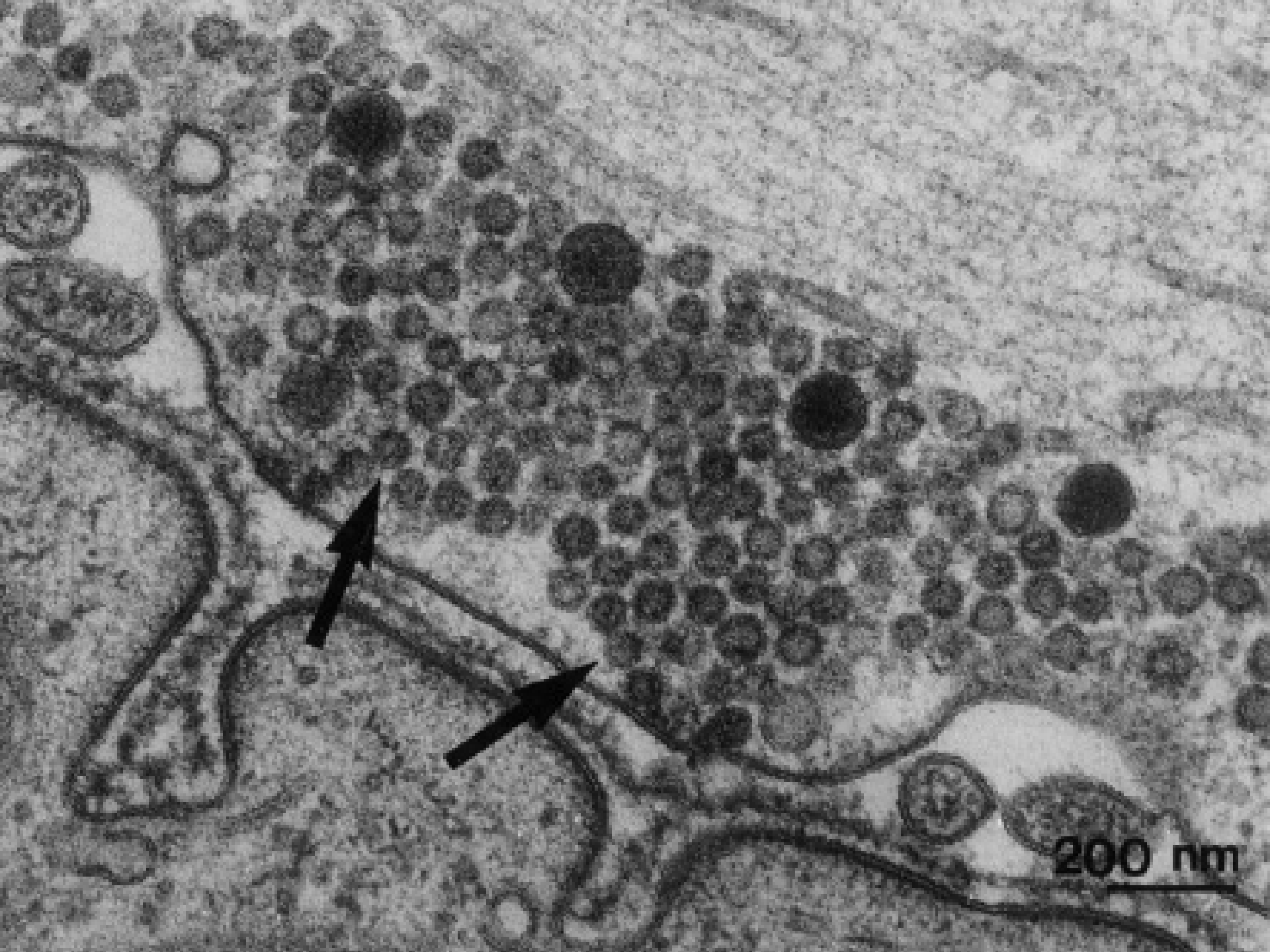
End Plate Potentials

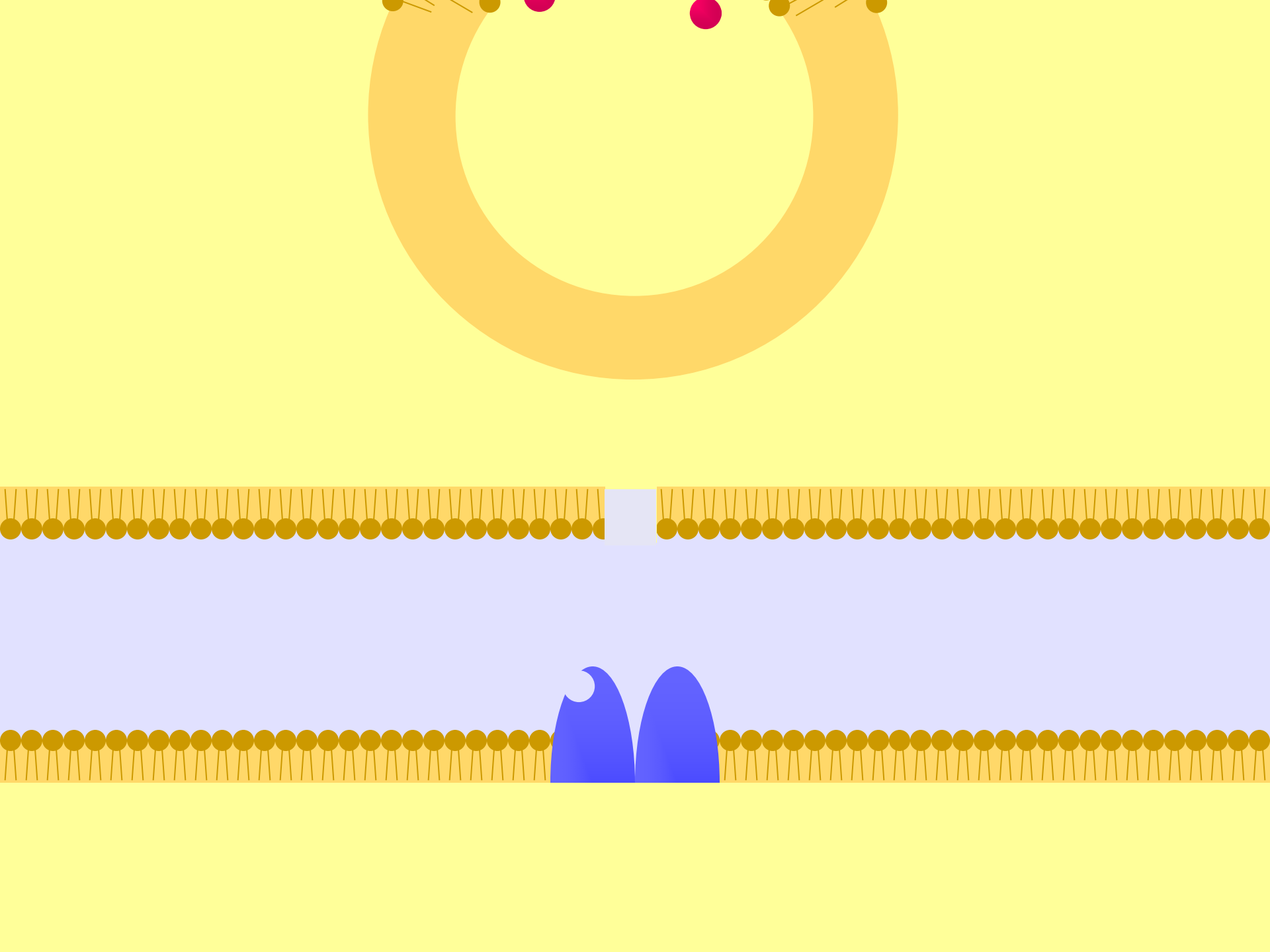


Miniature EPPs

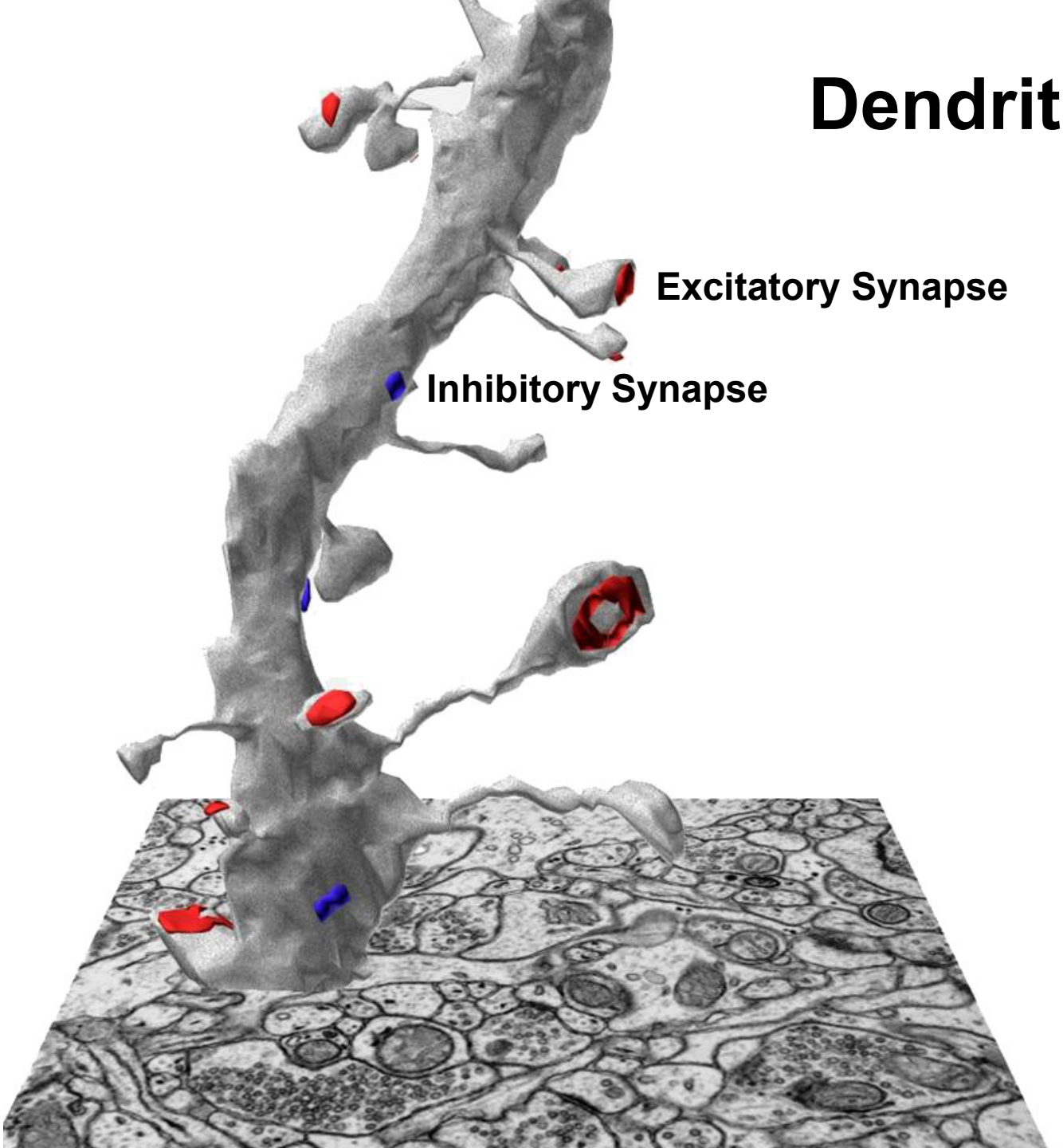
Bernard Katz

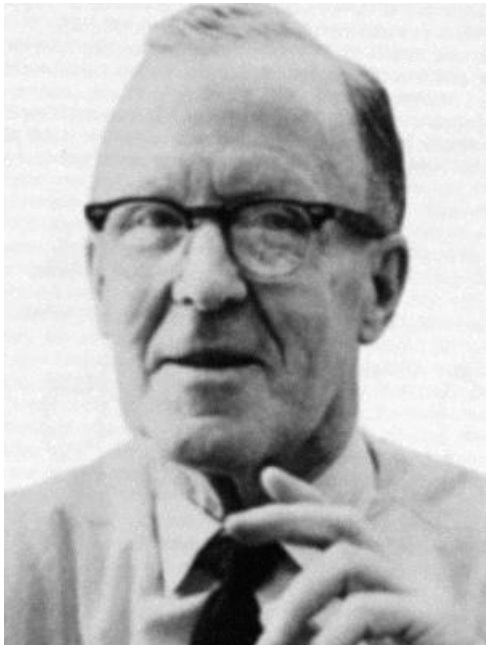



200 nm



Dendritic Spines

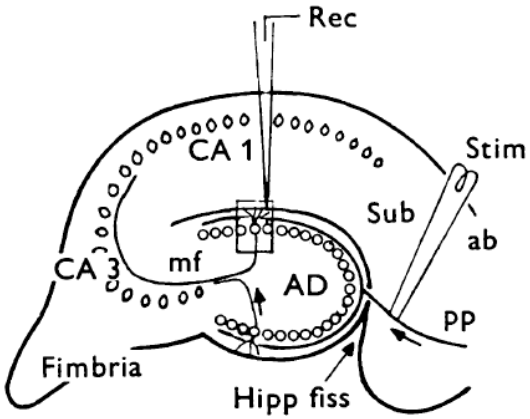


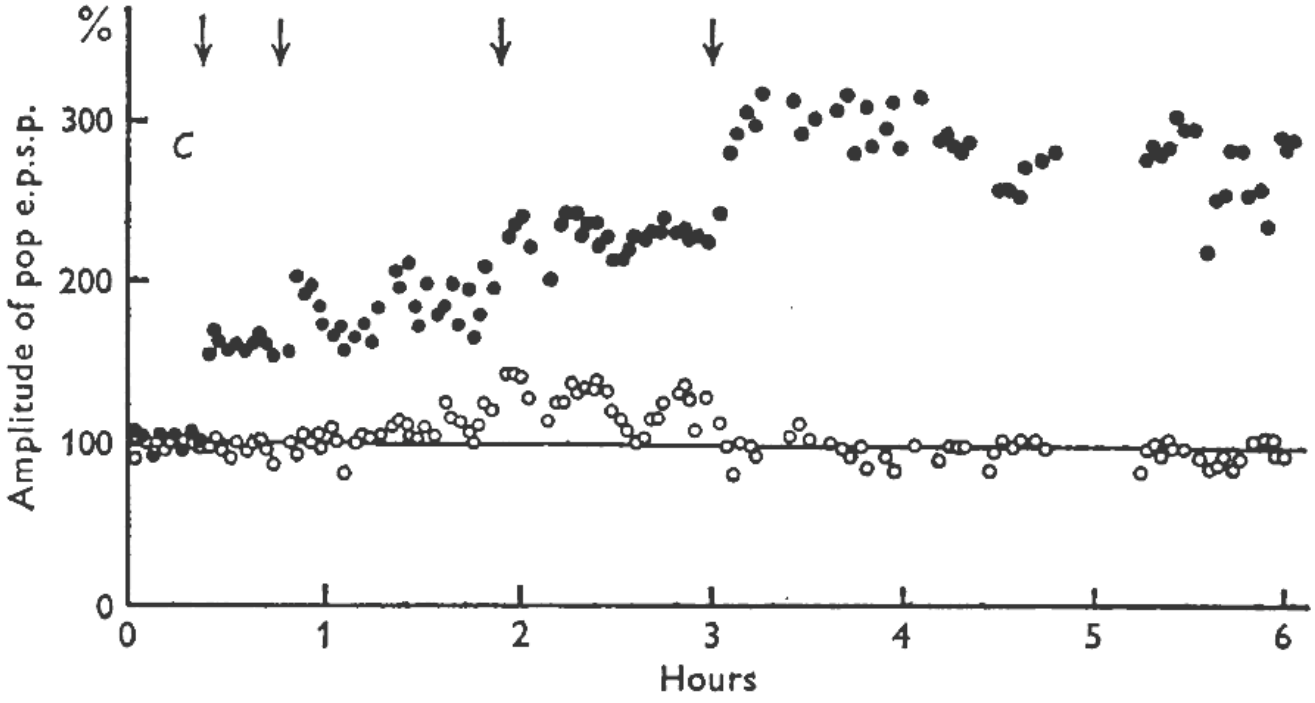


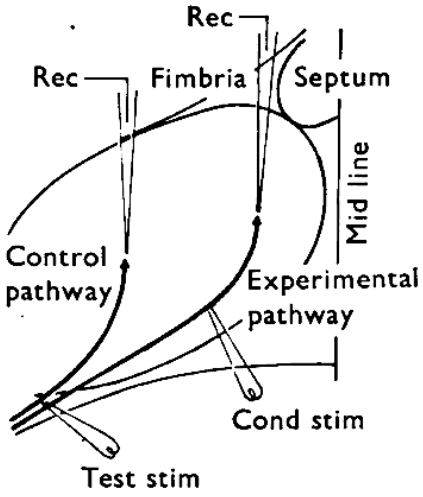
Donald Hebb

"Let us assume then that the persistence or repetition of a reverberatory activity (or "trace") tends to induce lasting cellular changes that add to its stability. …When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased."

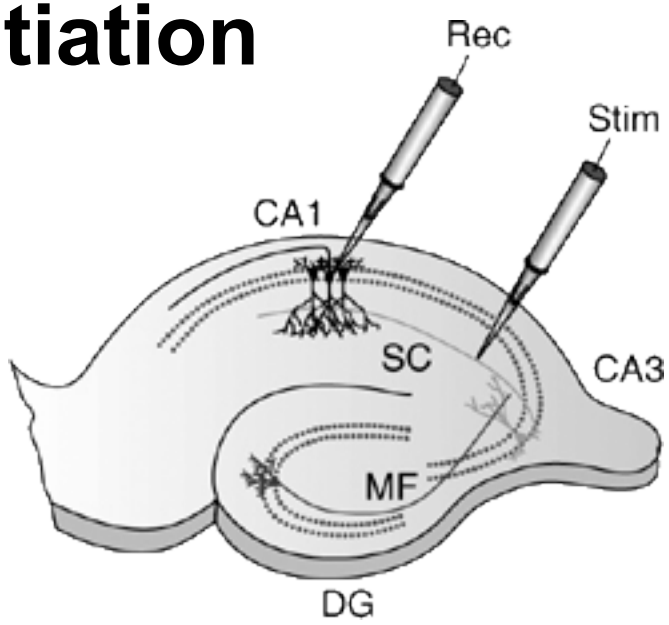
Terje Lømo

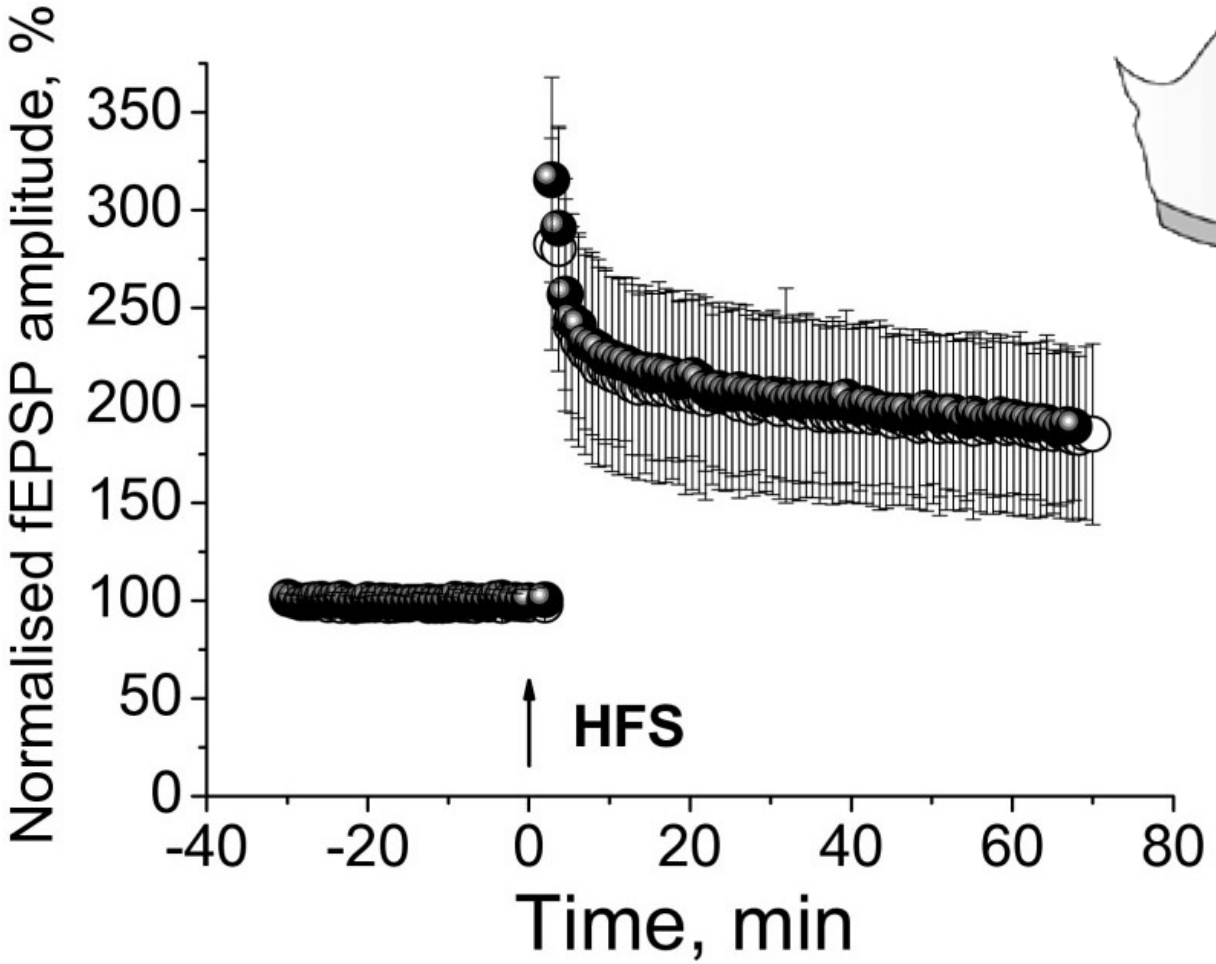

Rec
CA 1
Stim
Sub
ab
CA 3
mf
AD
PP
Fimbria
Hipp fiss


%
300
200
100
0
C
Amplitude of pop e.p.s.p.
0
1
2
3
4
5
6
Hours

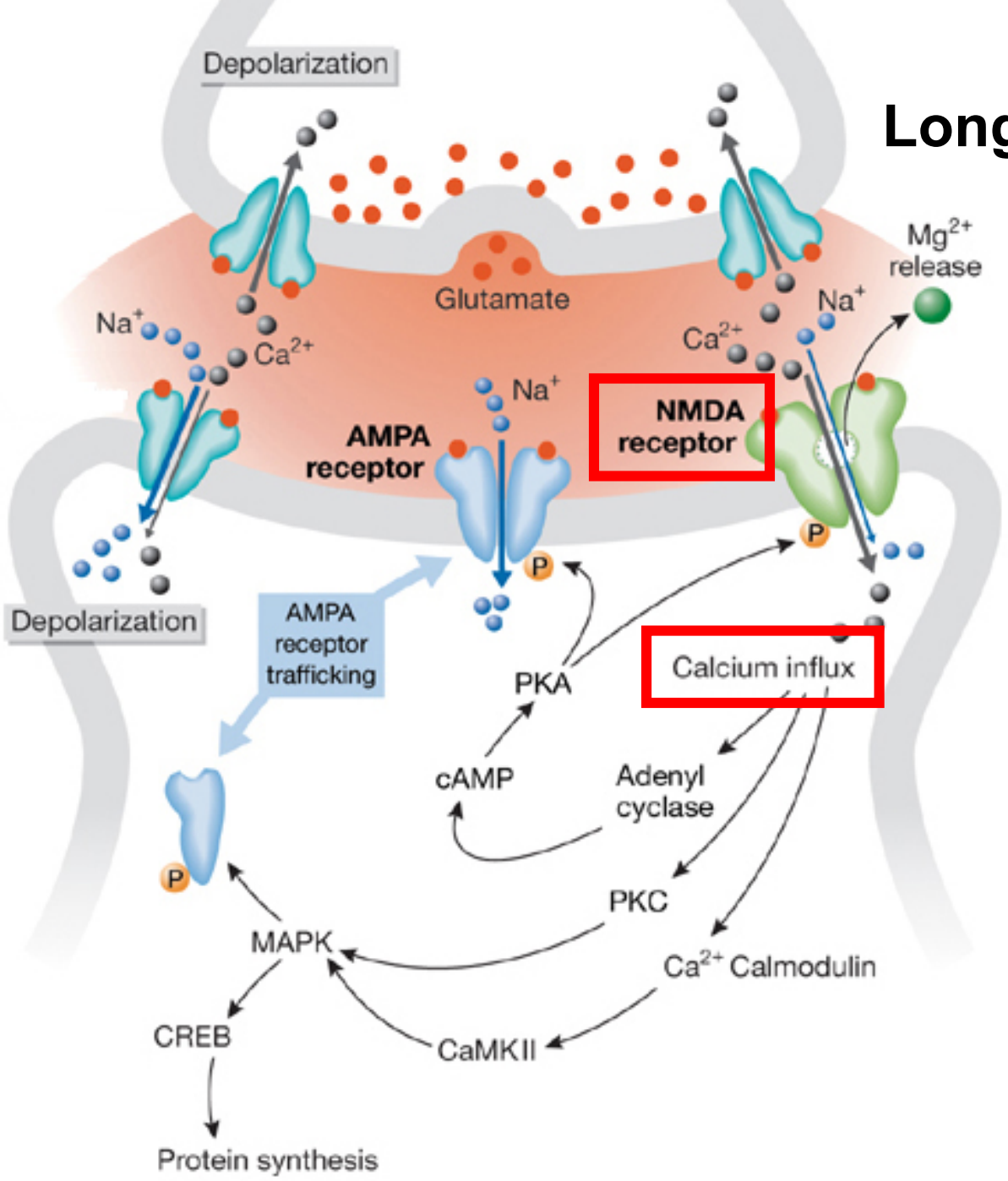

Rec
Rec
Fimbria
Septum
Mid line
Control pathway
Experimental pathway
Cond stim
Test stim

Long Term Potentiation





Long Term Potentiation



Depolarization of Postsynaptic Cell

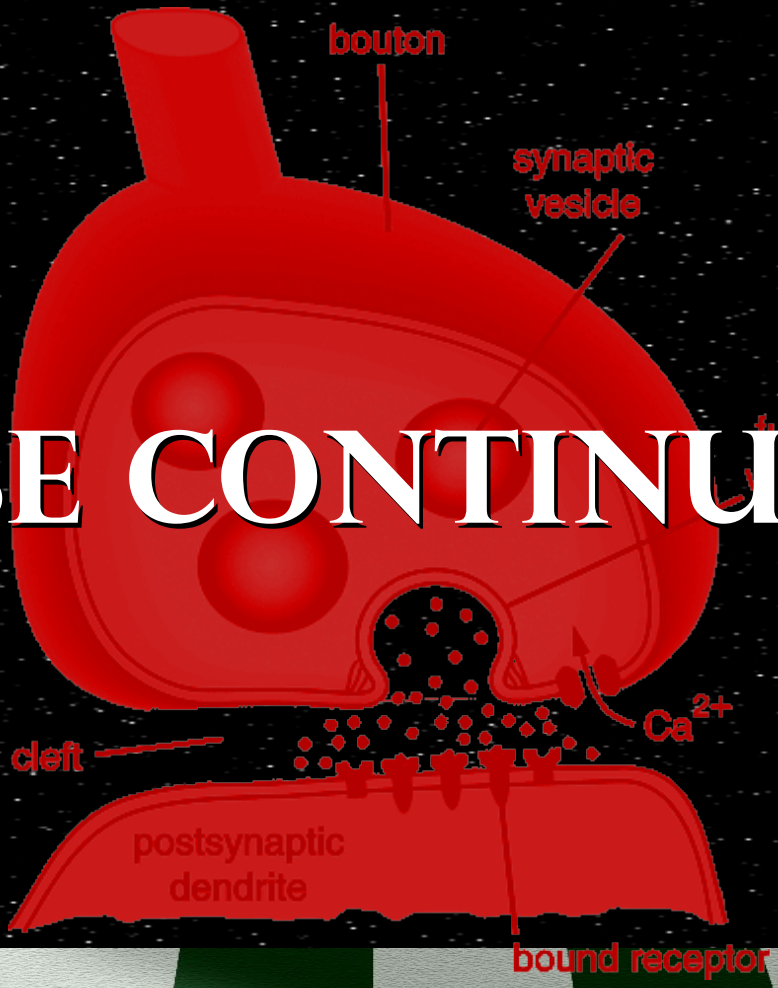
Release of NMDA Receptor Mg^{2+} Block

Ca^{2+} Influx

Ca^{2+}-dependent Signaling Cascades

Insertion of AMPA Receptors

Protein Synthesis



TO BE CONTINUED…