

Hiring:
I need a
room

Cleaner
KICK FOR DETAIL?

Ion Channels & Cellular Electrophysiology

Pumps

ATP-Driven Pumps

Na-K Pump

Na-K Gradients

Channels

Equilibrium Potential

Ion-Selective Channels

Channel Gating

pump
active

pump
active

pump

pump

channel

passive

V_m

sodium channel
 E_{Na}

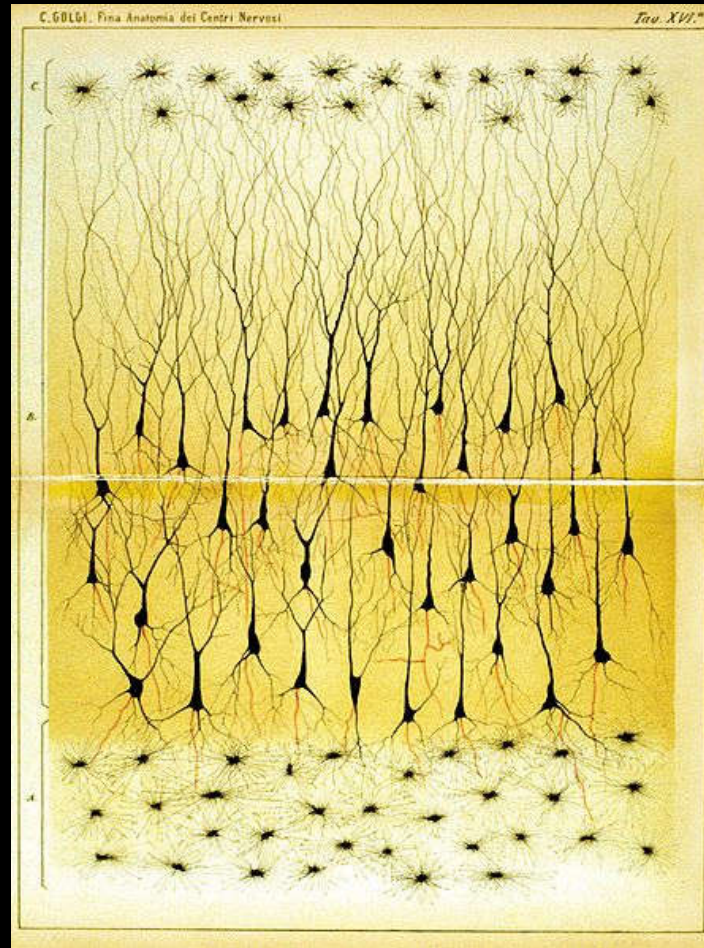
potassium channel

voltage sensor
voltage-gated
ligand binding site
ligand-gated
mechanical sensor
mechanically-gated
outside
inside
membrane

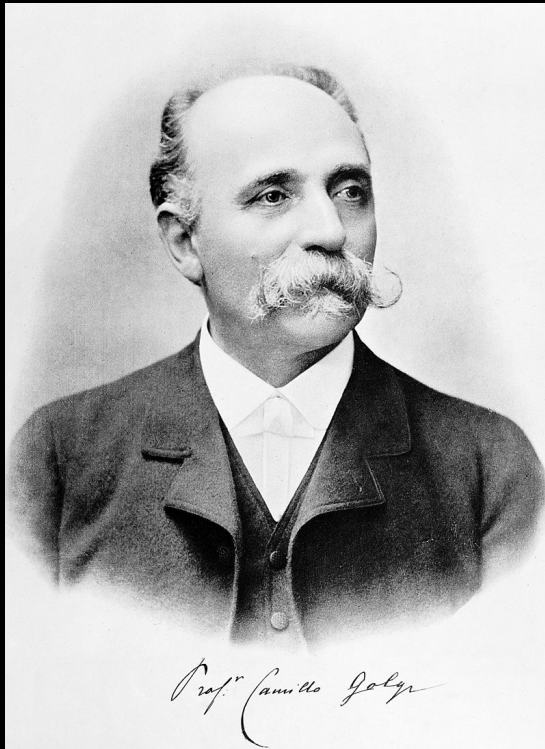
Synaptic Transmission & Neurotransmitter Receptors



Two Ways Neurons Can Communicate



Two Ways Neurons Can Communicate

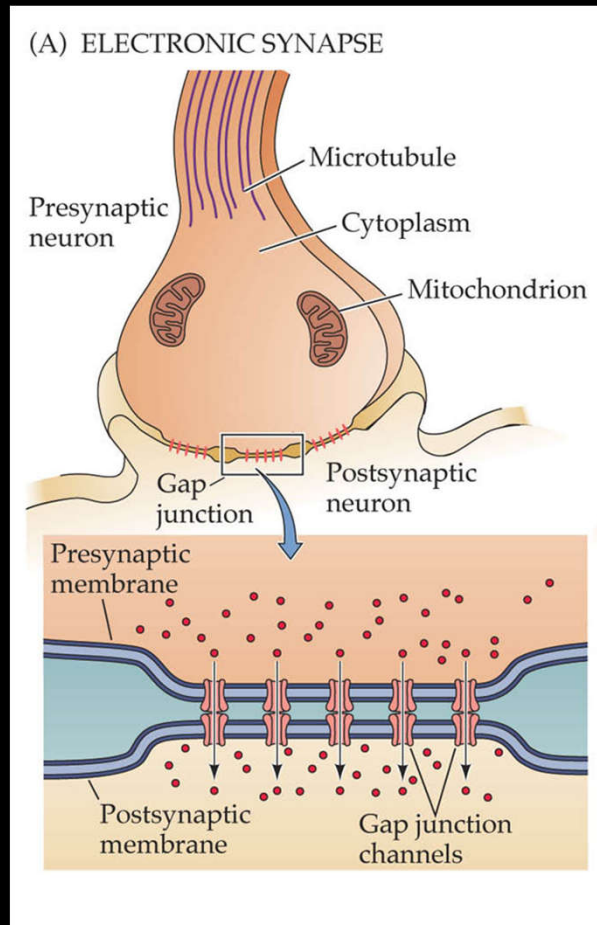


Camillo Golgi

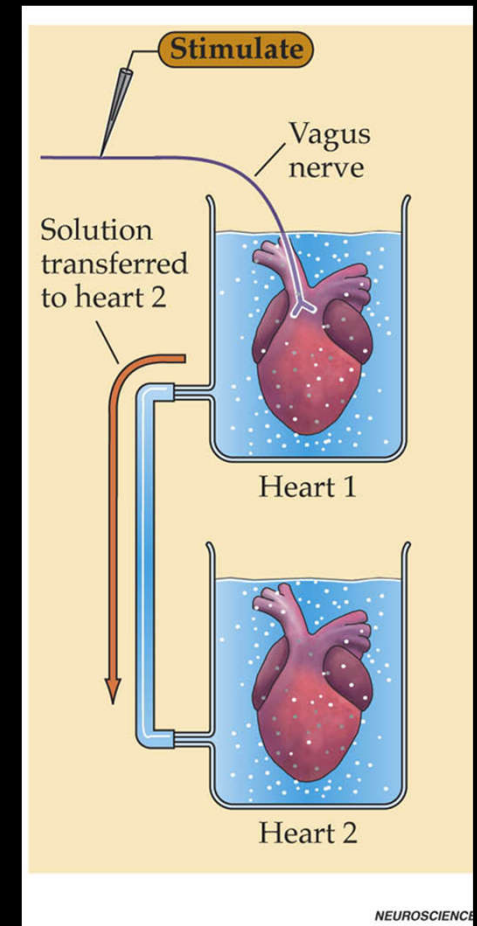
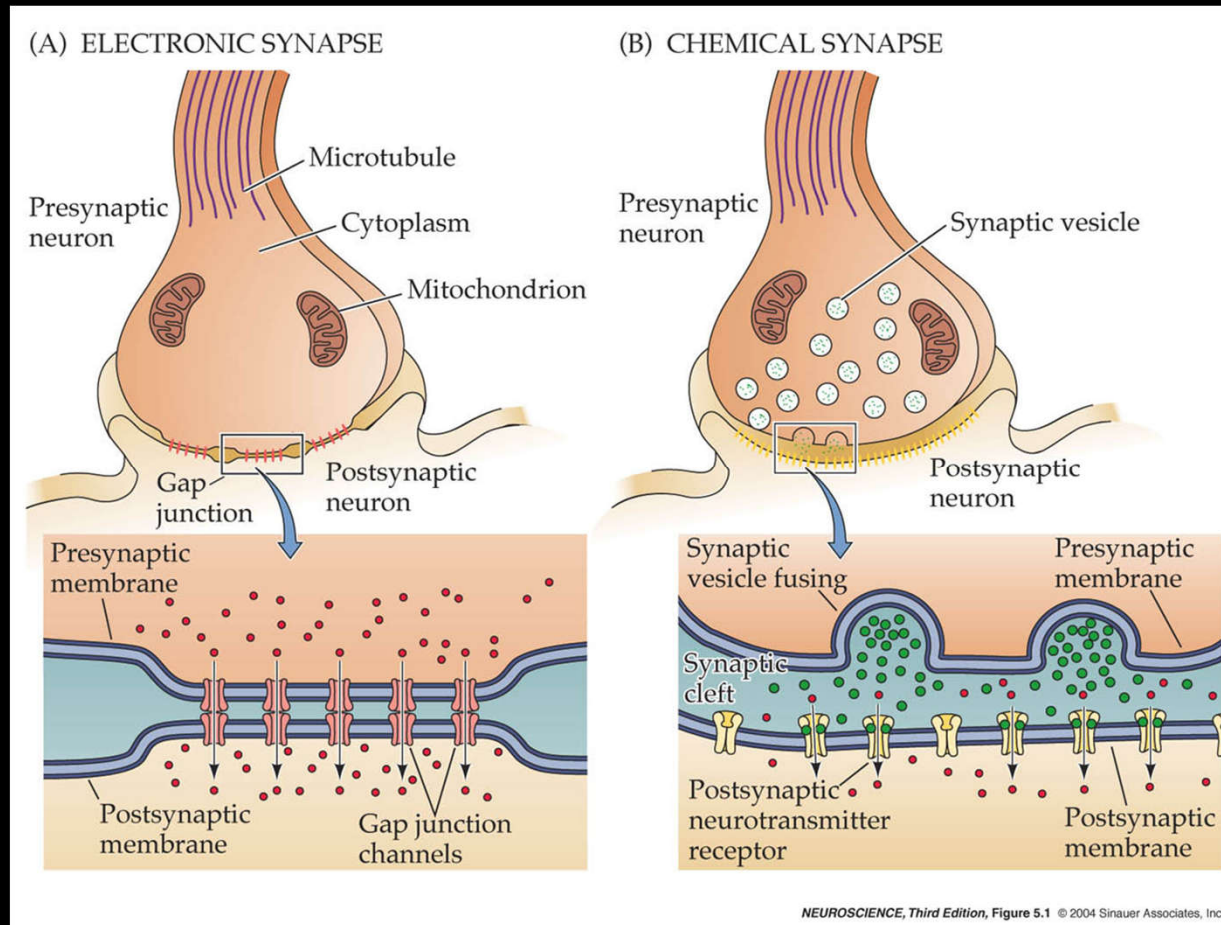


Santiago Ramon y Cajal

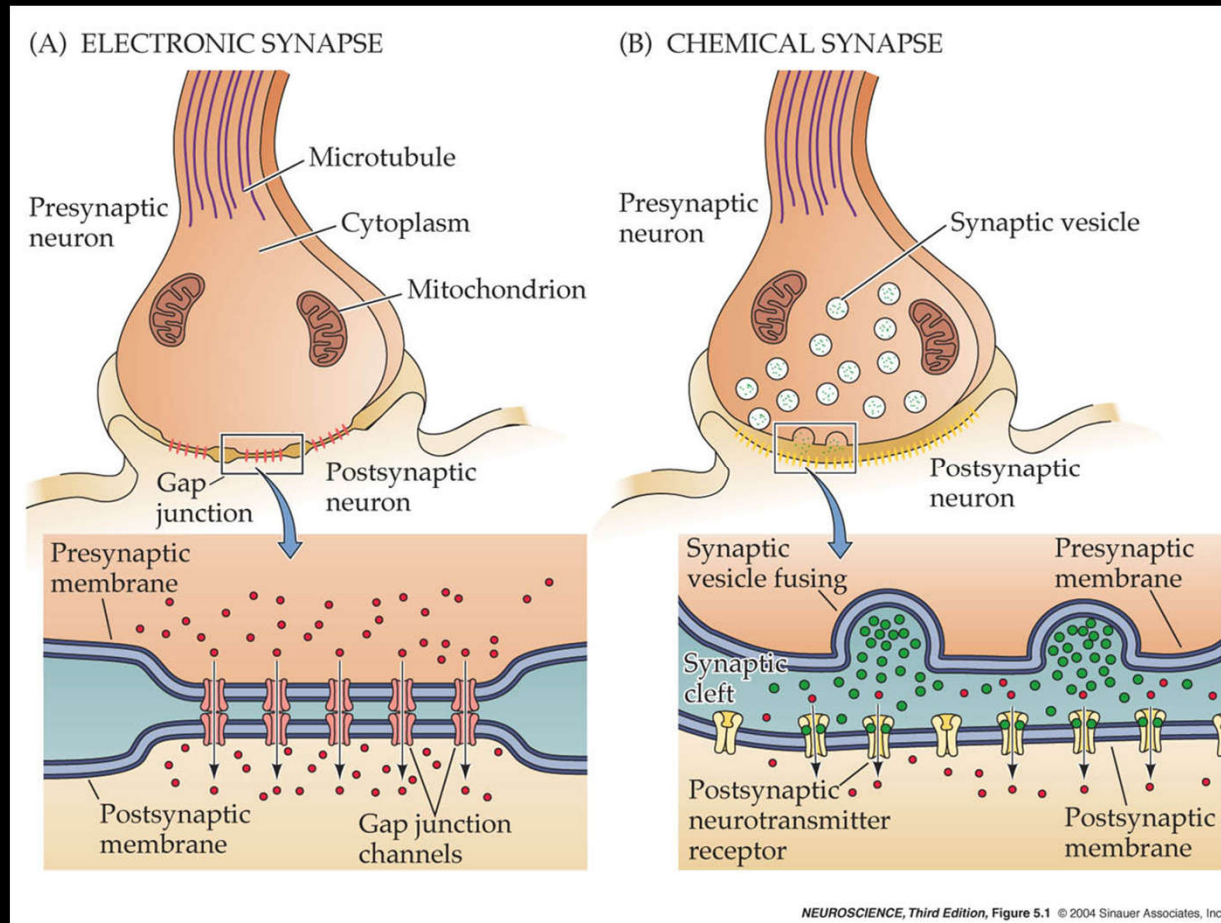
Two Ways Neurons Can Communicate



Two Ways Neurons Can Communicate

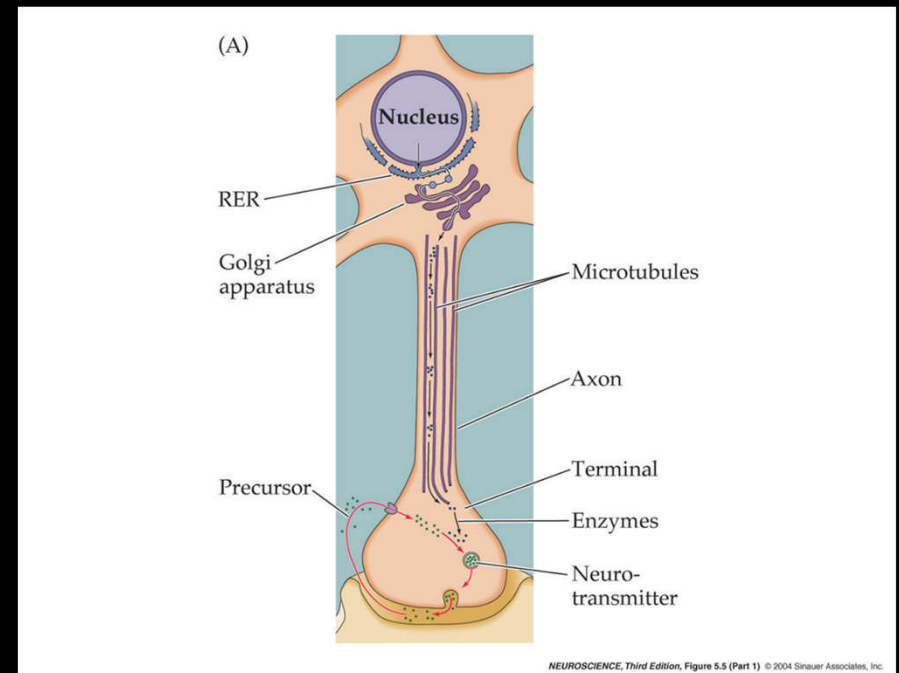
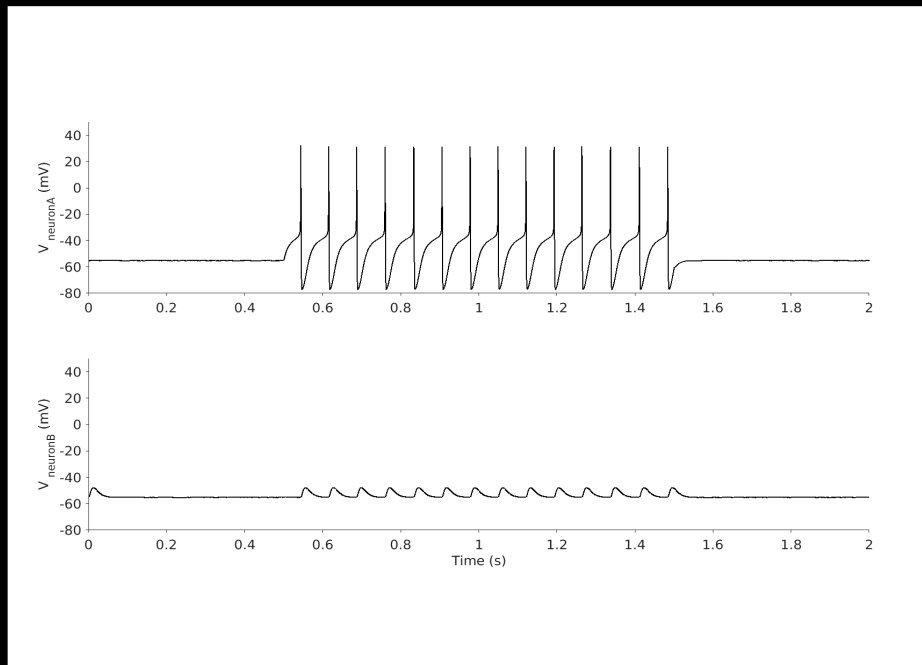


Two Ways Neurons Can Communicate

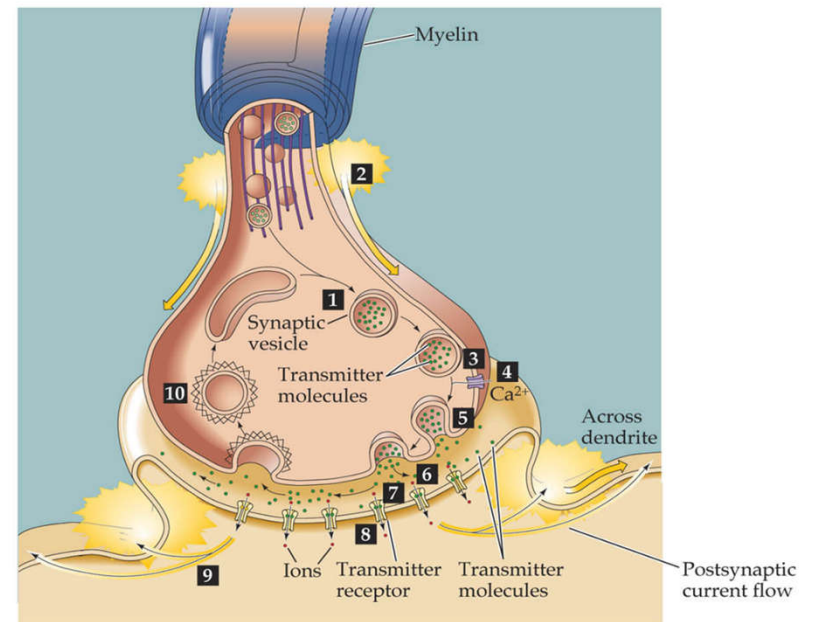
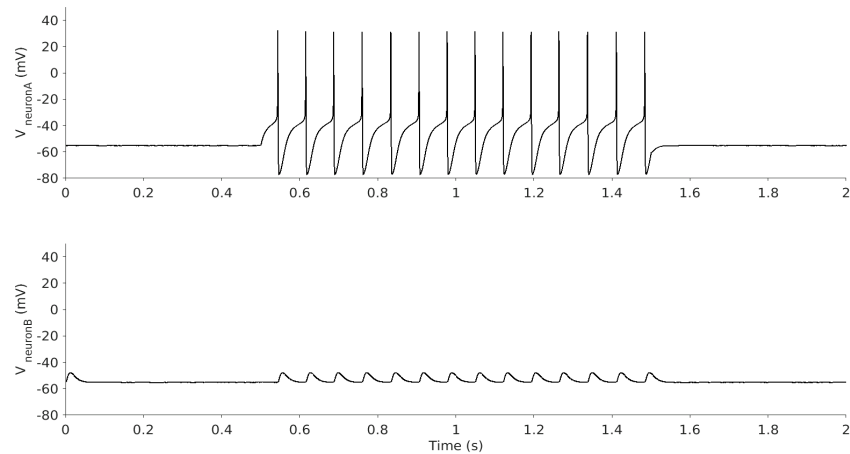


Otto Loewi

Special Structures For Neurotransmission

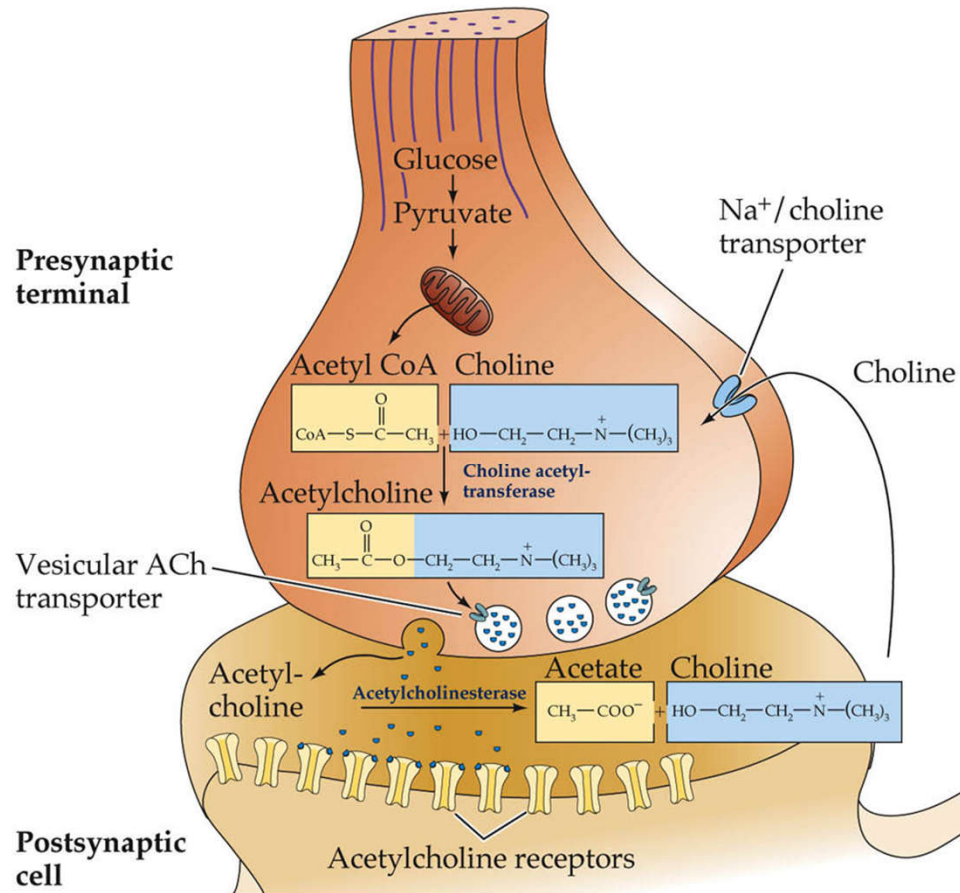


Steps of Neurotransmission

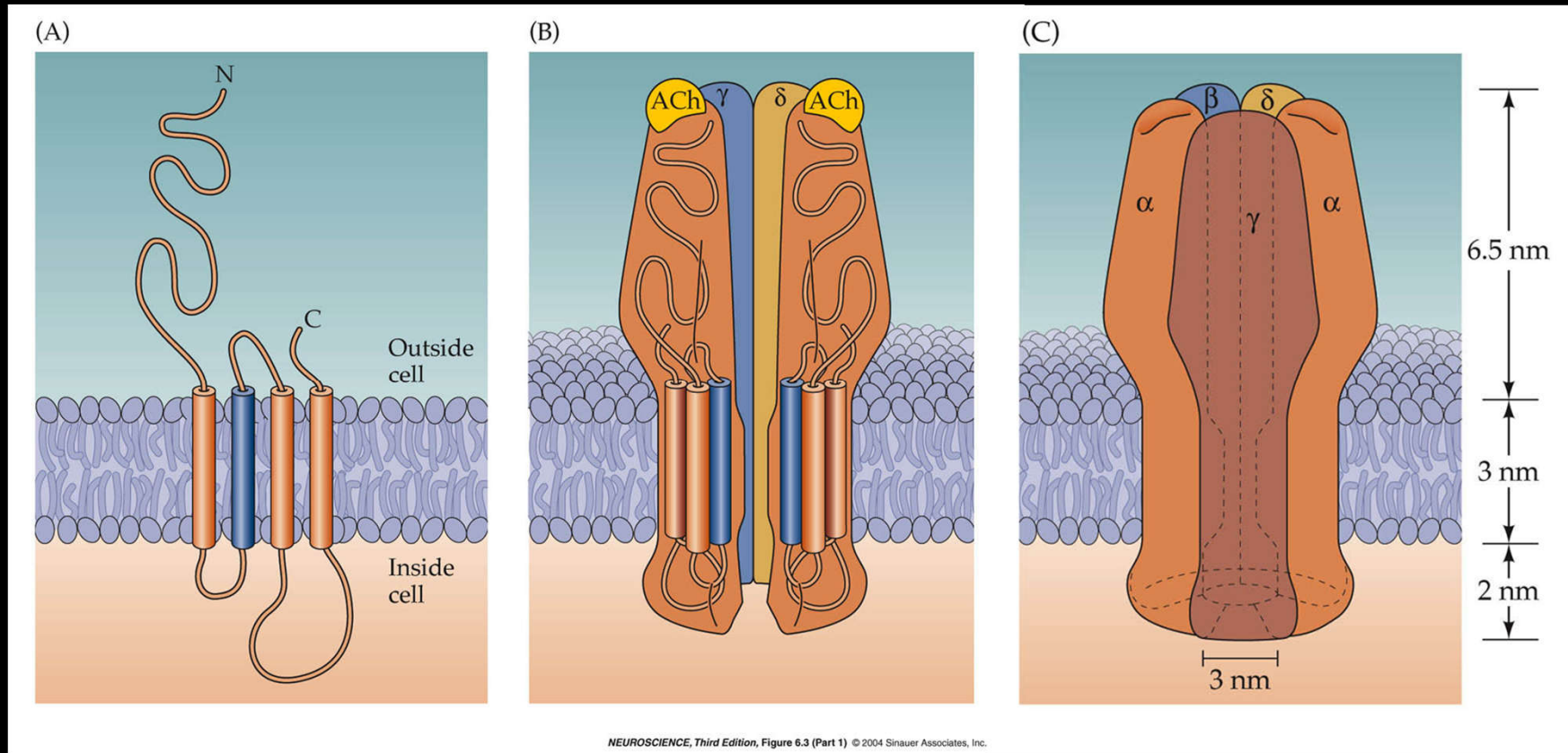


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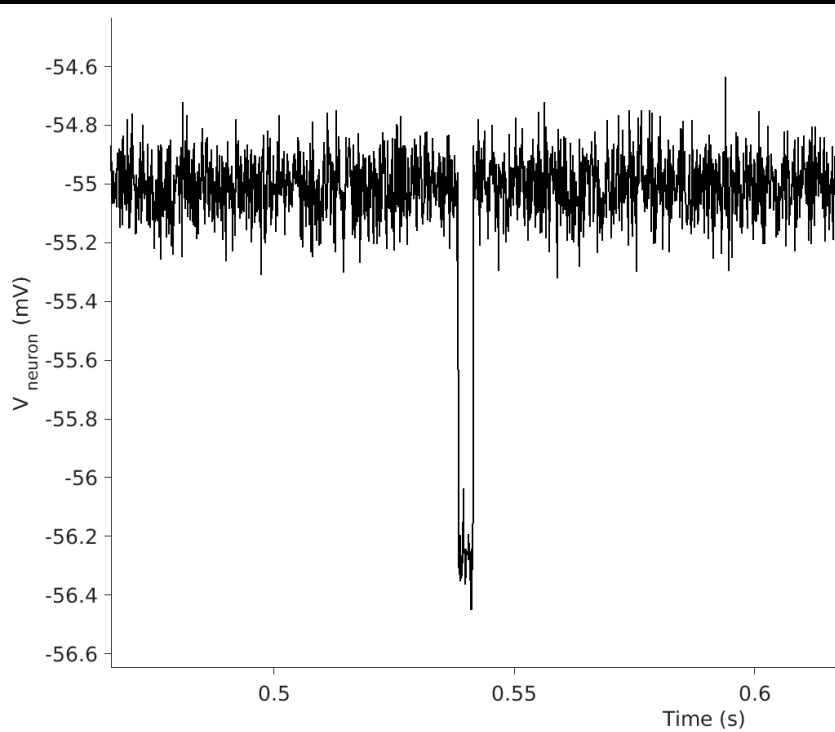
Cholinergic Synapse



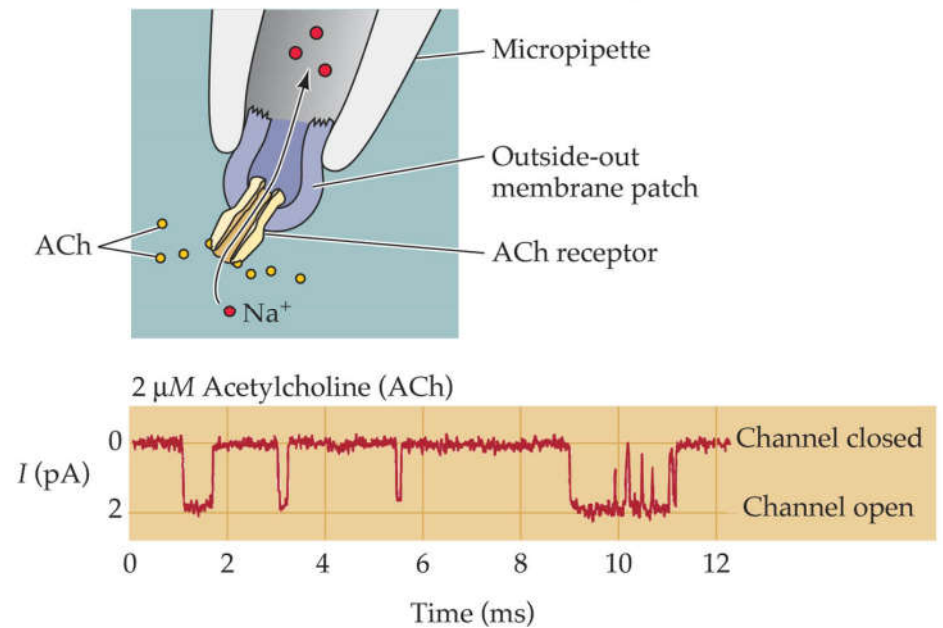
Acetylcholine Receptor



Cholinergic Currents



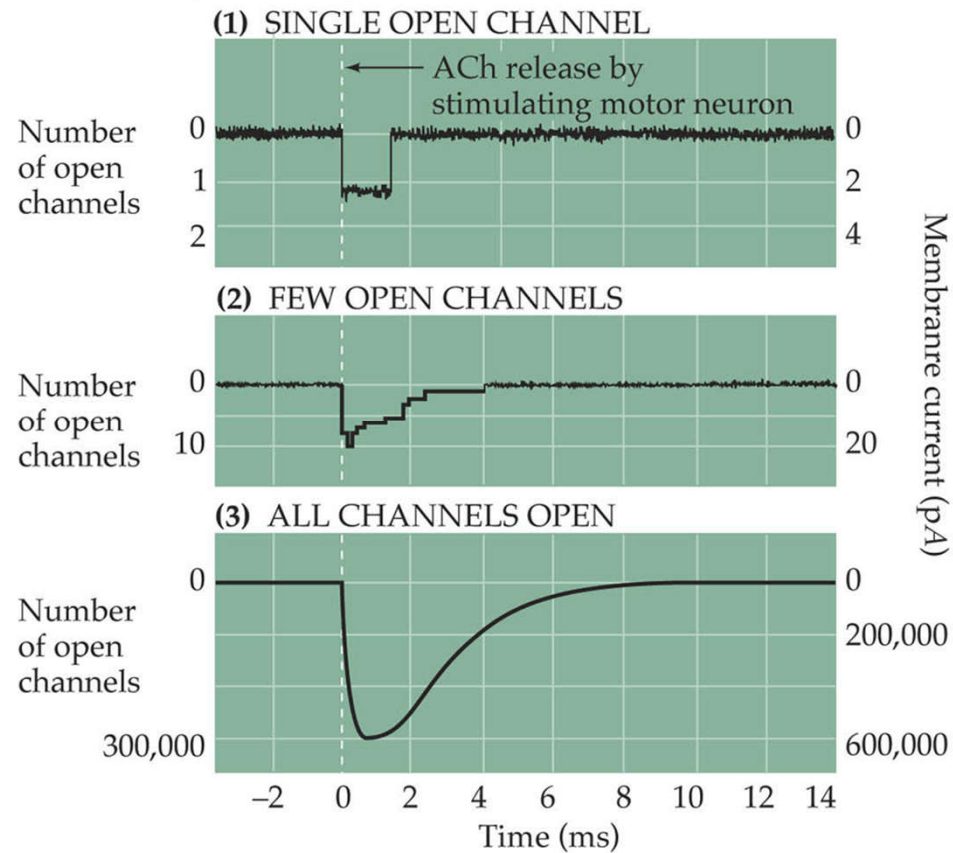
(A) Patch clamp measurement of single ACh receptor current



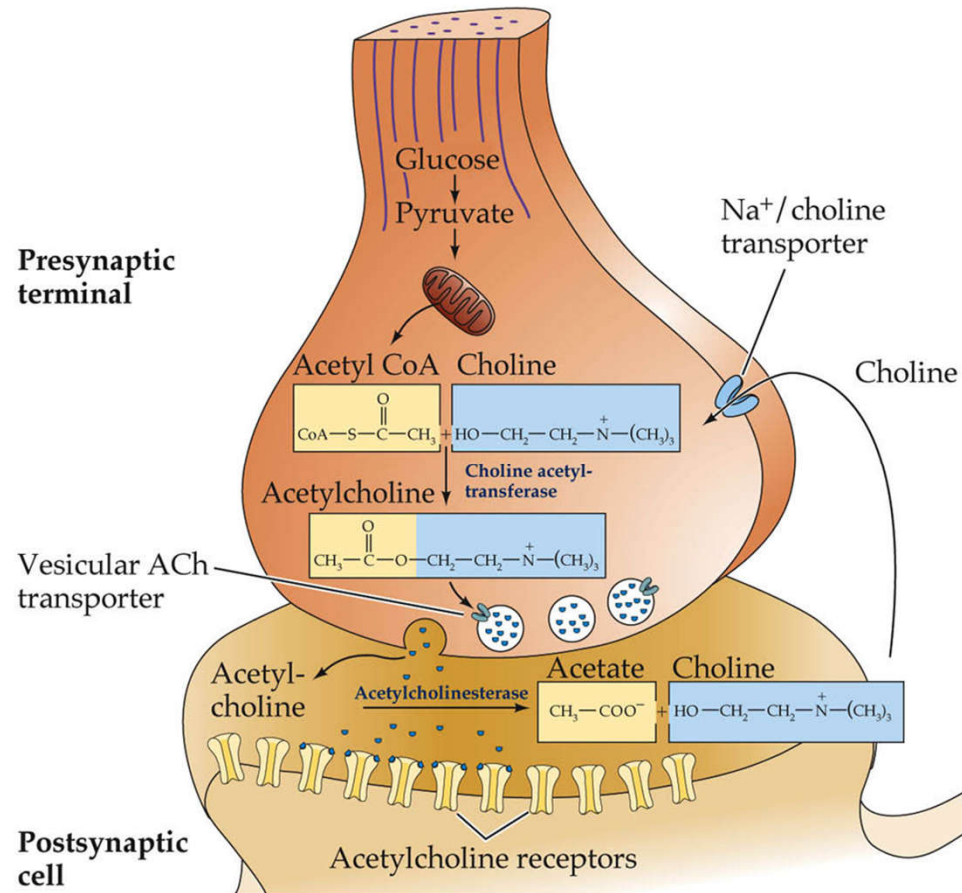
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Cholinergic Currents

(B) Currents produced by:



Cholinergic Currents



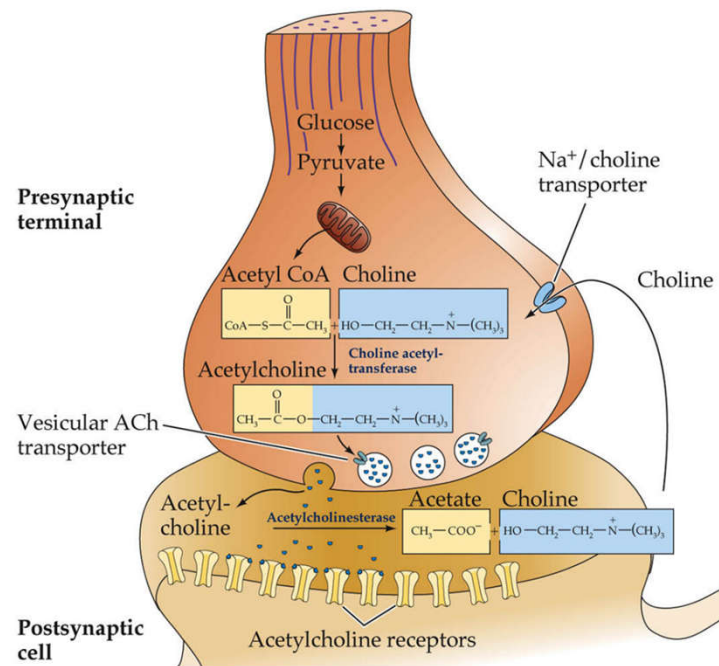
Recording Synapses

Presynaptic & Postsynaptic

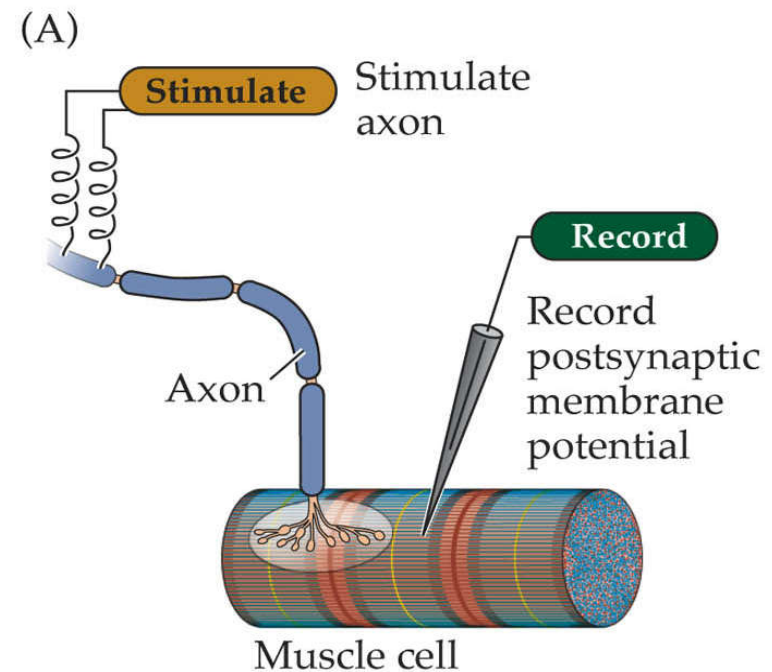
Recording Synapses

Presynaptic & Postsynaptic

Voltage



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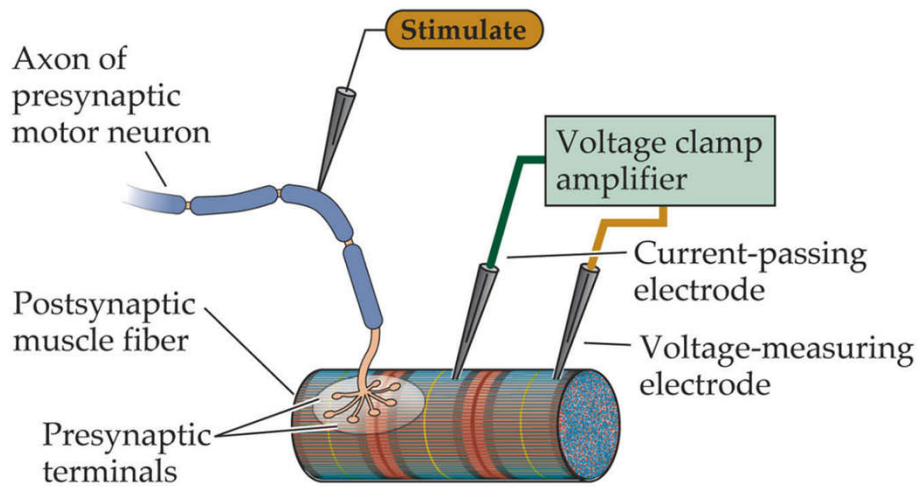


Recording Synapses

Presynaptic & Postsynaptic

Current

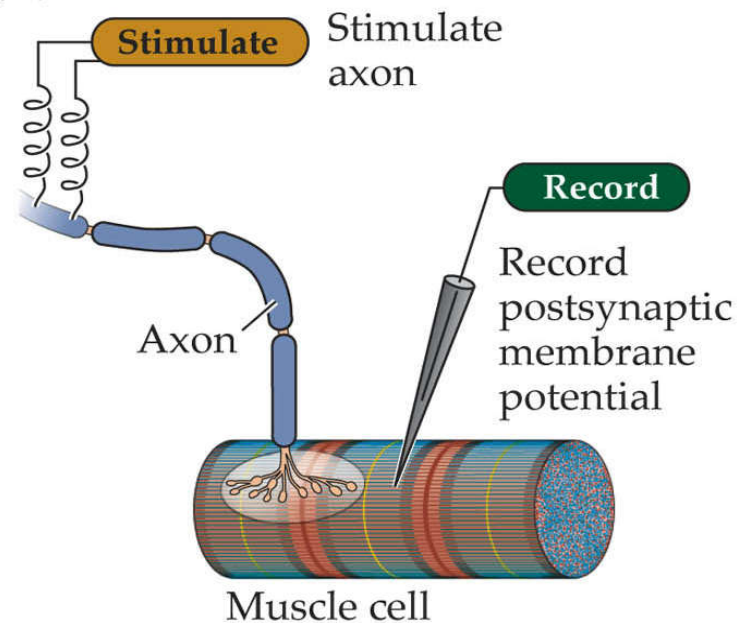
(A) Scheme for voltage clamping postsynaptic muscle fiber



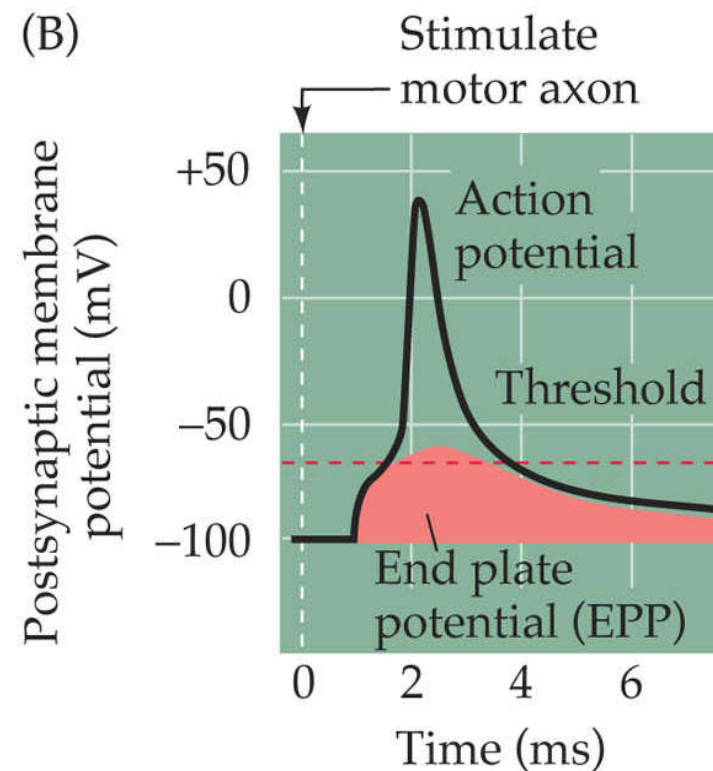
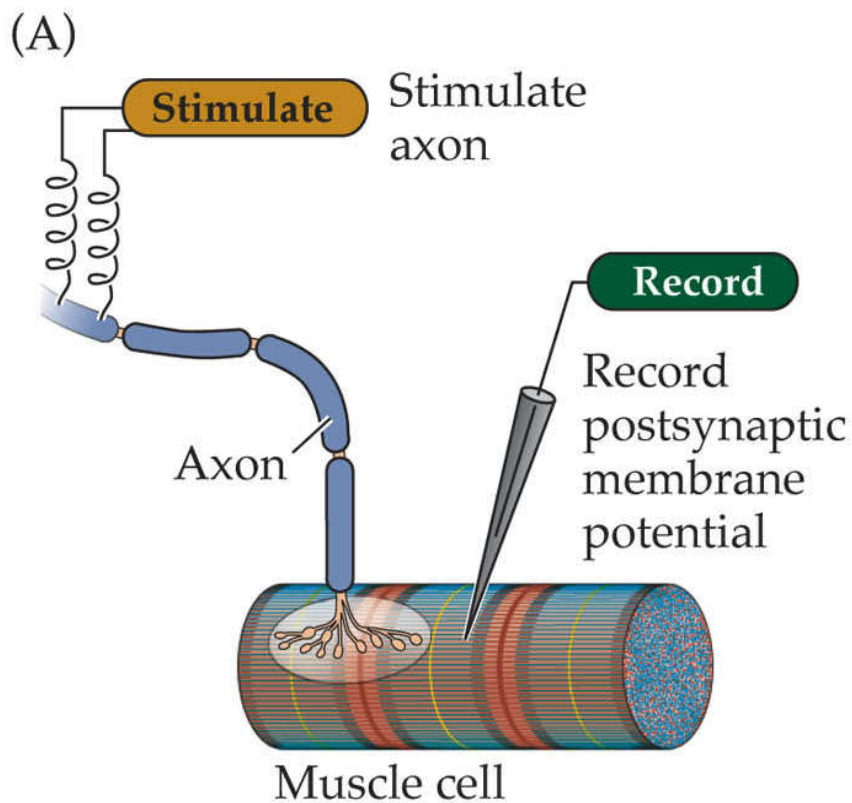
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Voltage

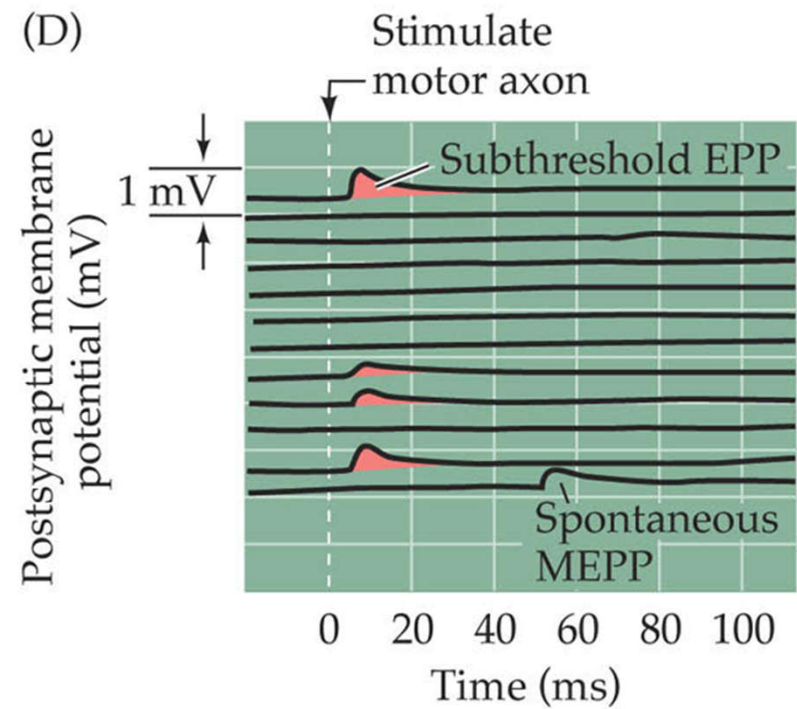
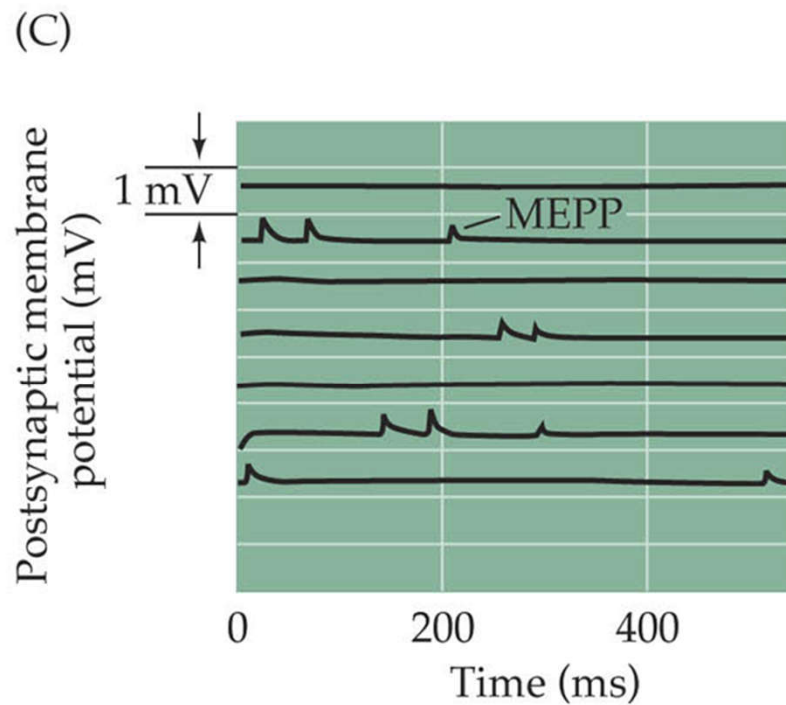
(A)



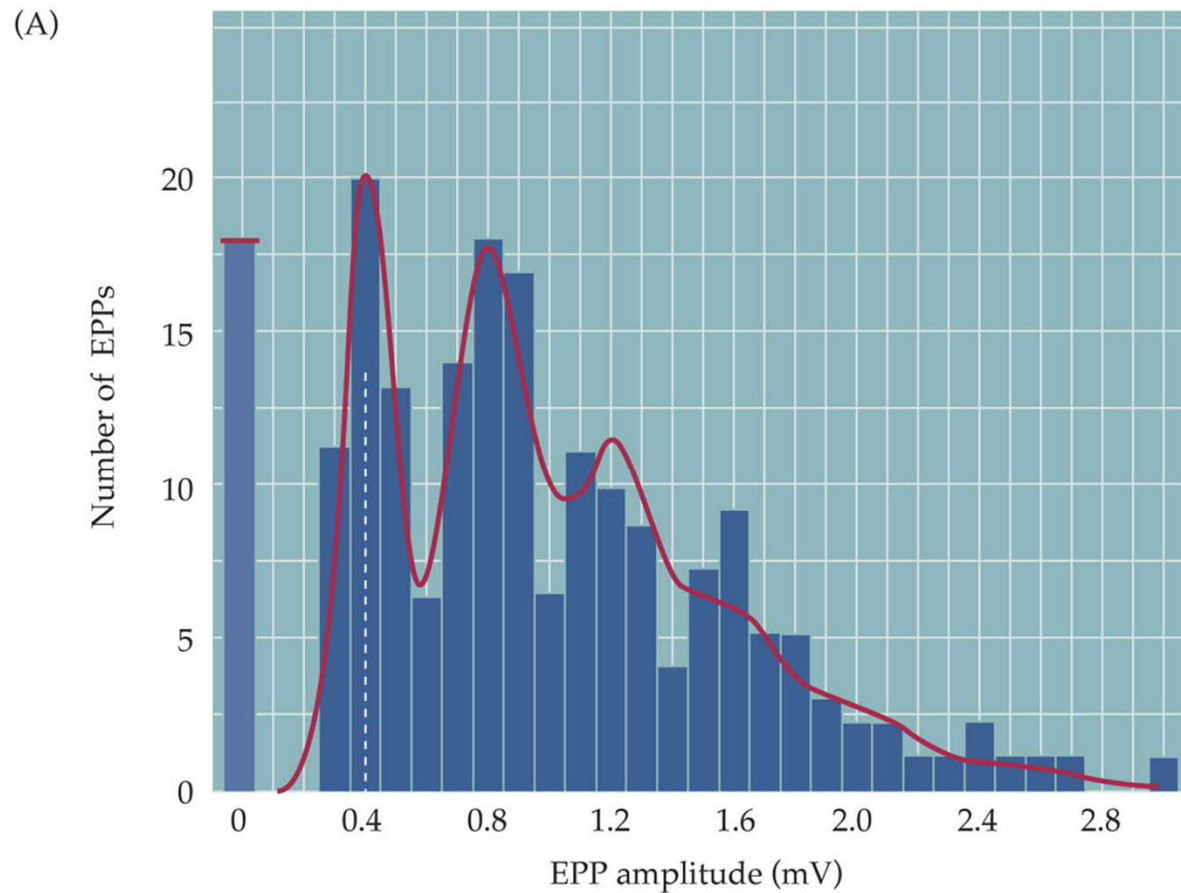
Neuromuscular Junction: Model for Synaptic Function



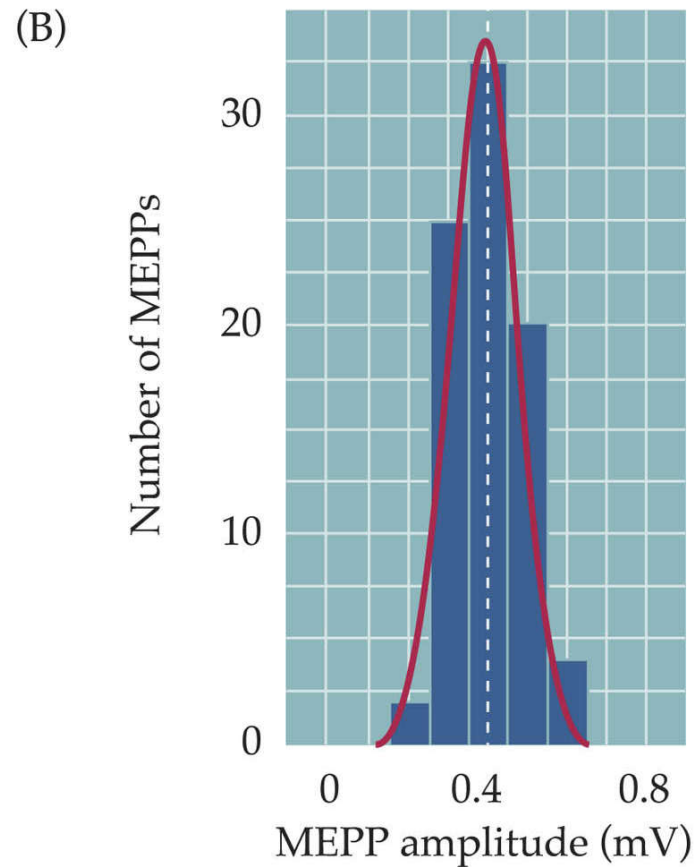
Muscle Recordings



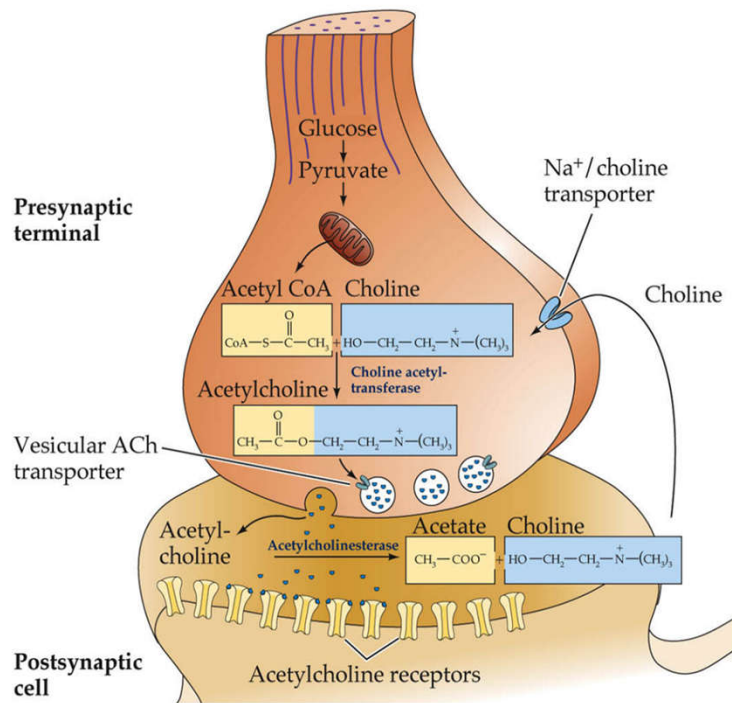
Distribution of EPP Amplitudes



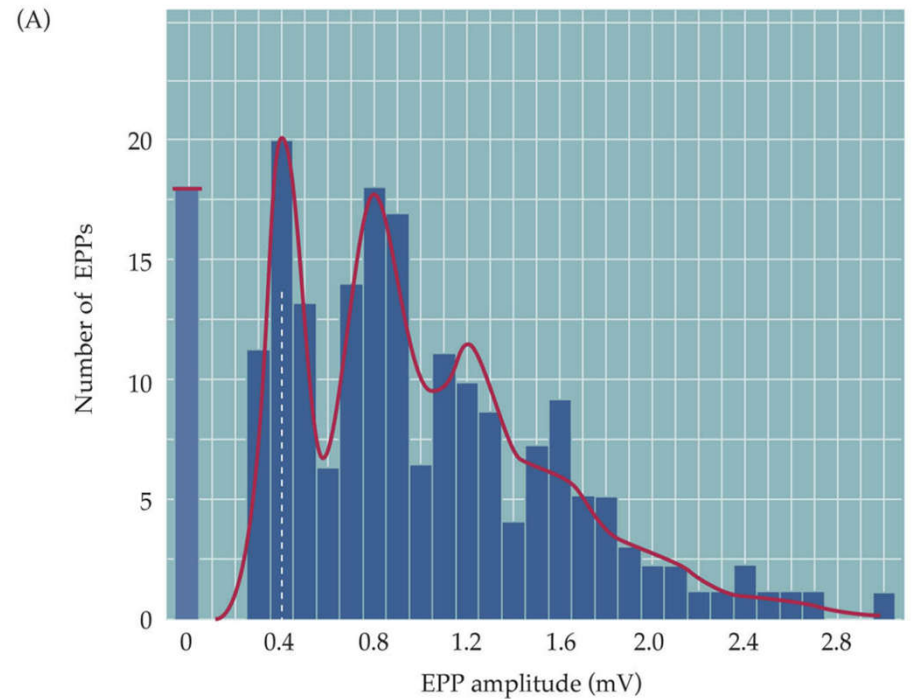
Quantal Transmission



Quanta Represent Single Vesicles



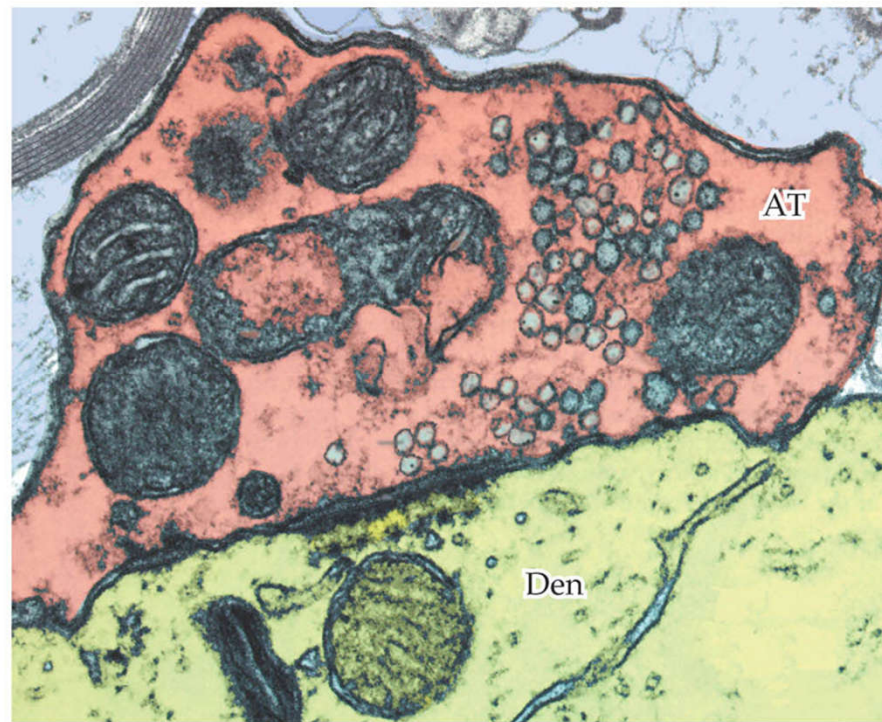
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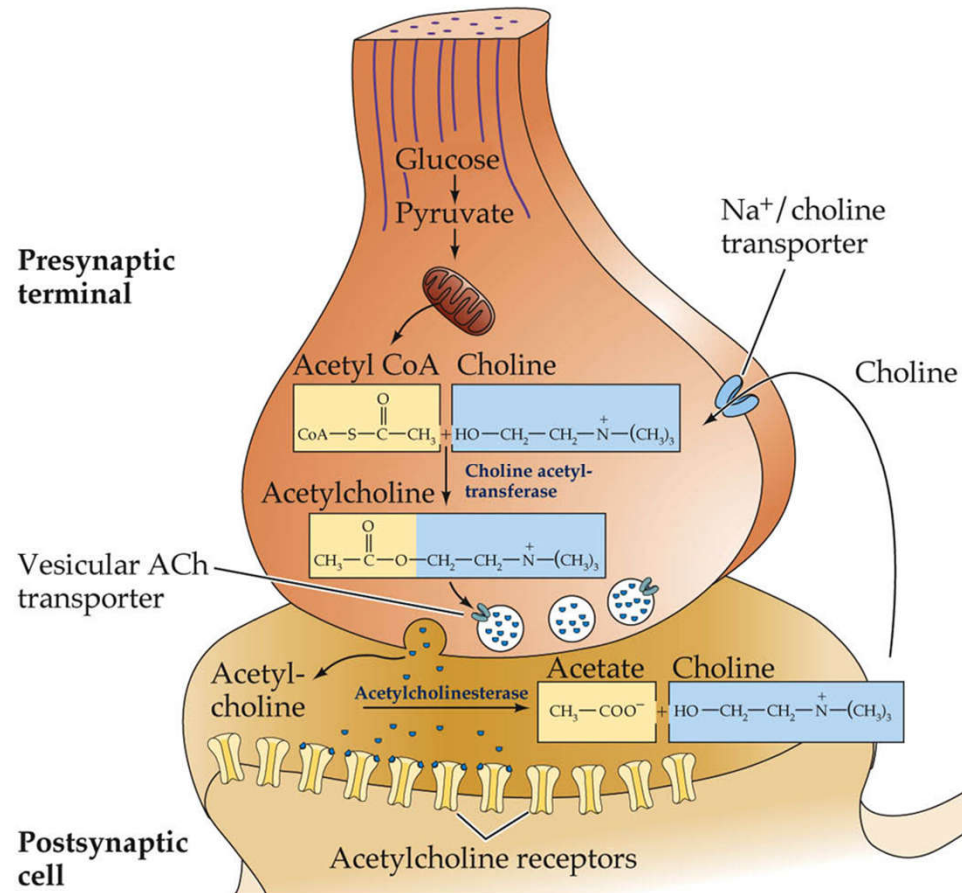
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Vesicles at a Real Synapse

(B)

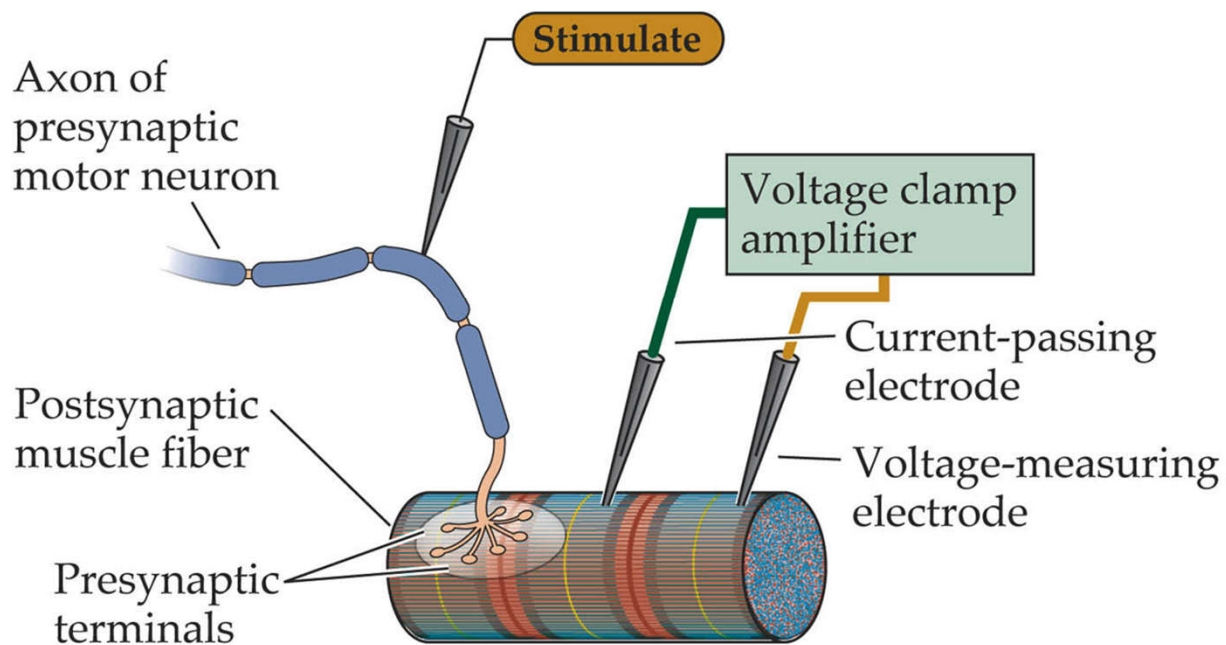


Cholinergic Synapse



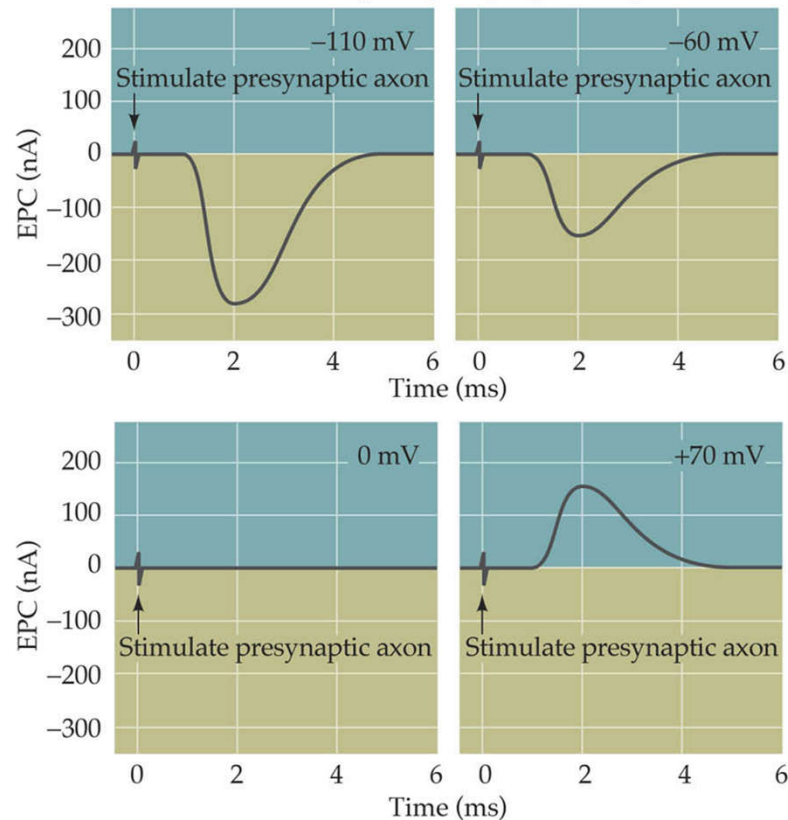
Recording Synaptic Currents

(A) Scheme for voltage clamping postsynaptic muscle fiber

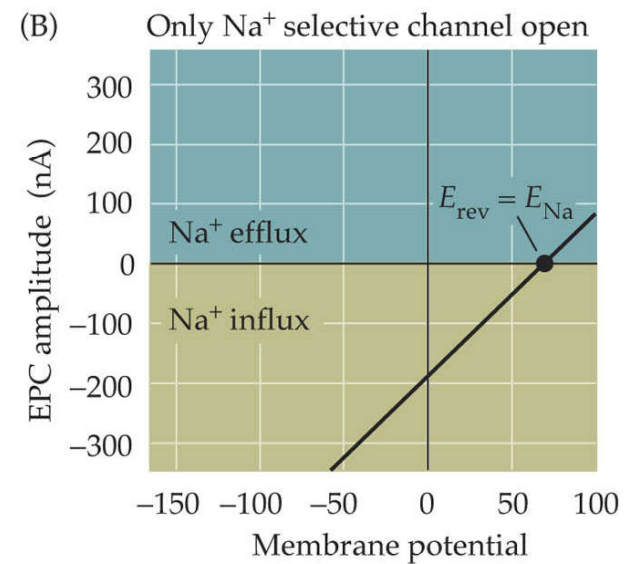
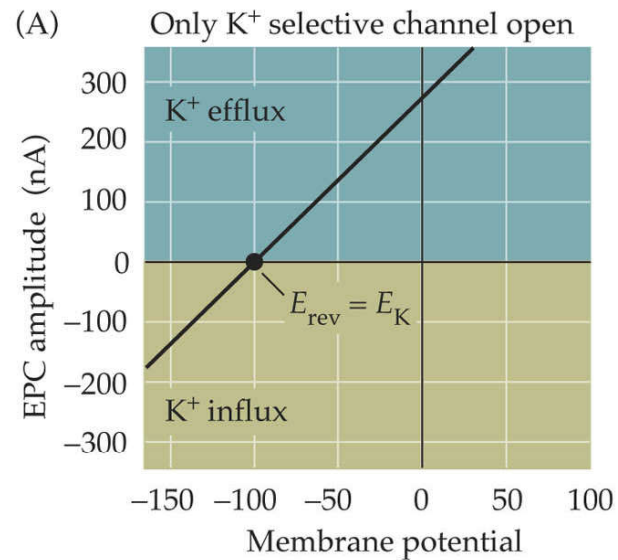


Membrane Potential Determines Current Flow

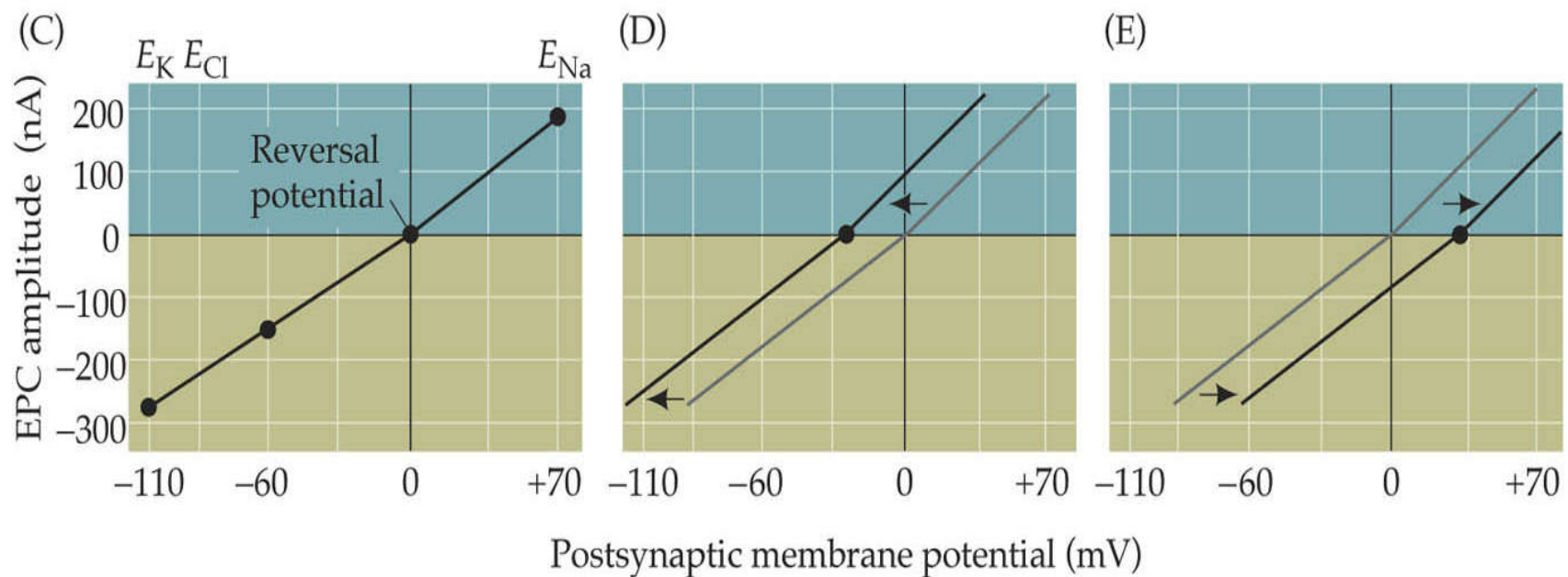
(B) Effect of membrane voltage on postsynaptic end plate currents



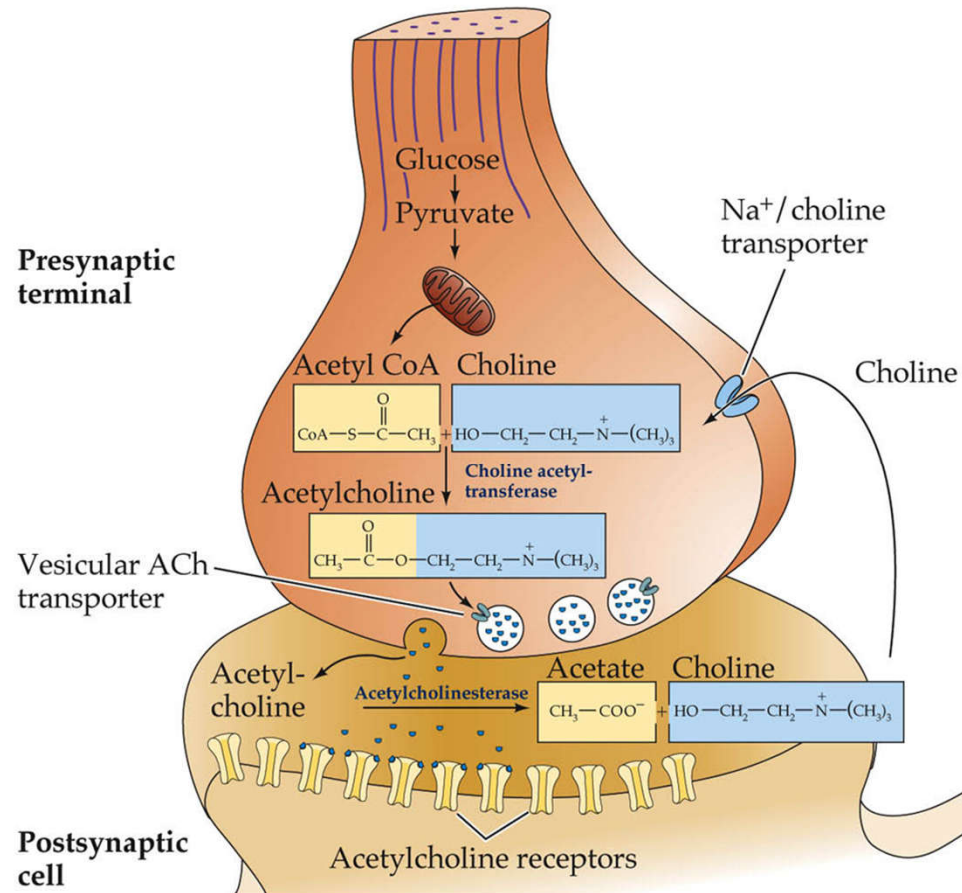
Equilibrium Potentials



Test Your Hypothesis

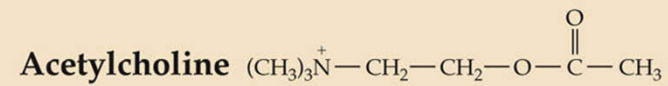


Cholinergic Synapse



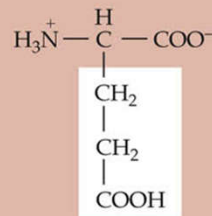
Neurotransmitters

SMALL-MOLECULE NEUROTRANSMITTERS

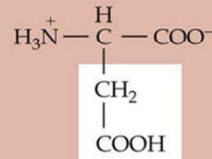


AMINO ACIDS

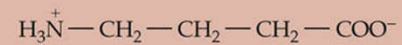
Glutamate



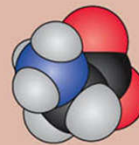
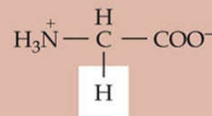
Aspartate



GABA



Glycine

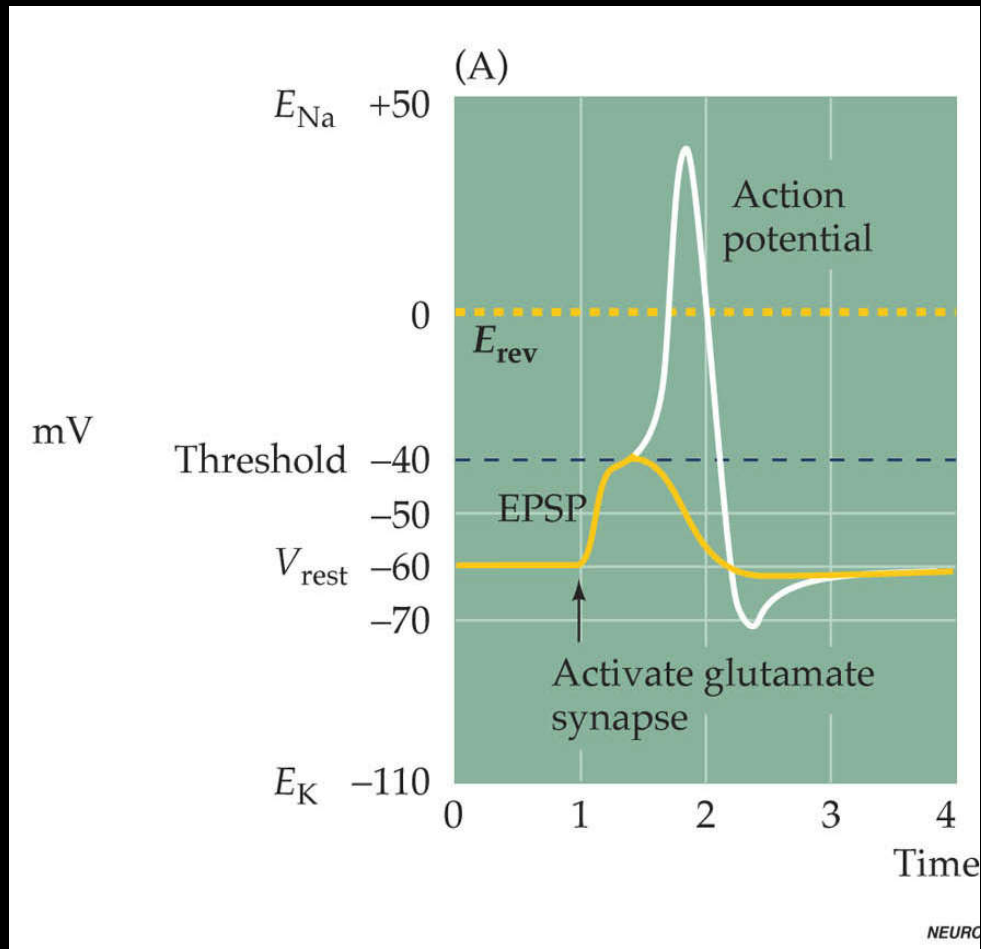


Neurotransmitters

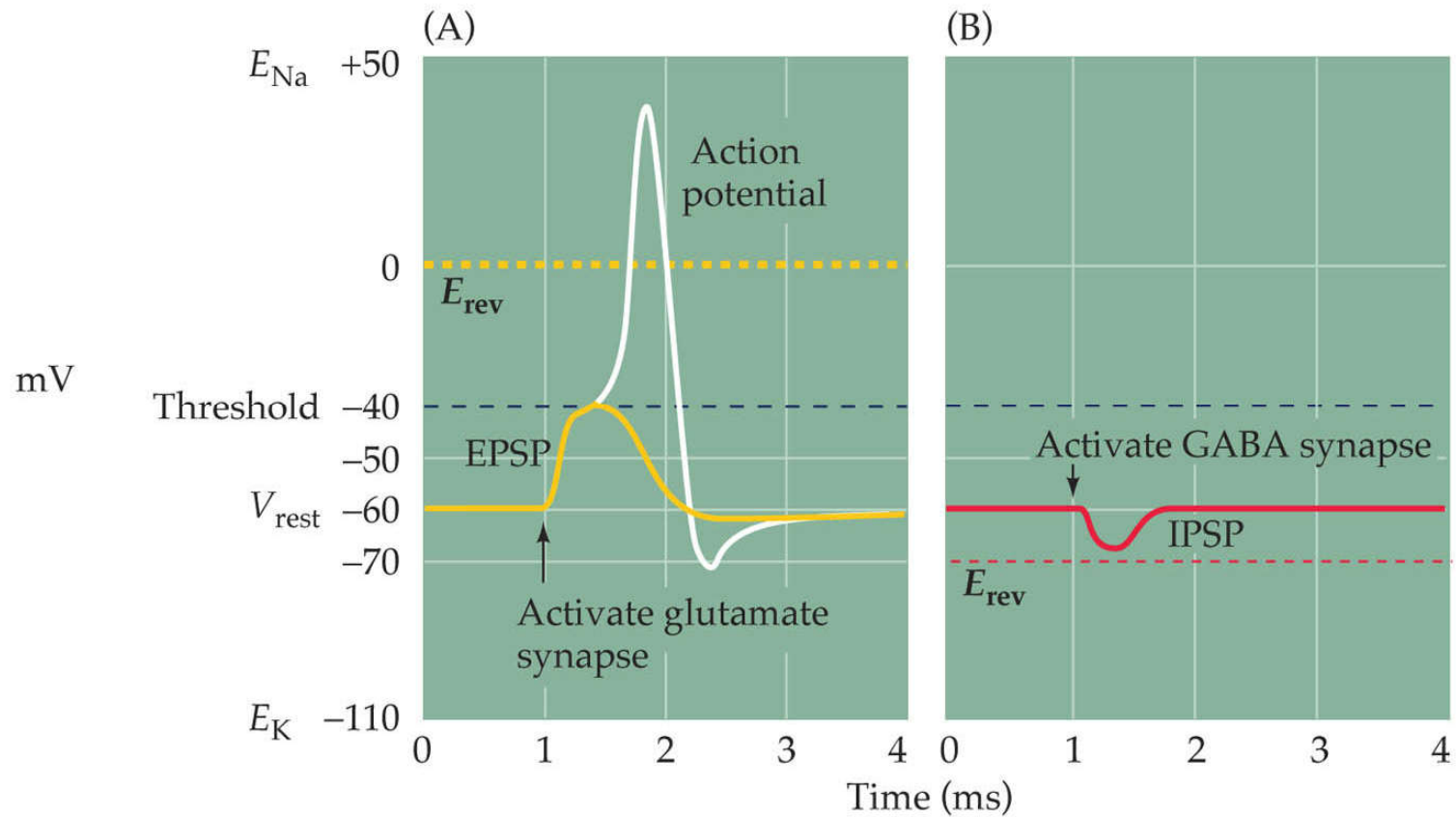
(C)

Receptor	AMPA	NMDA	Kainate	GABA	Glycine	nACh	Serotonin	Purines
Subunits	Glu R1	NR1	Glu R5	α_{1-7}	$\alpha 1$	α_{2-9}	5-HT ₃	P _{2X1}
	Glu R2	NR2A	Glu R6	β_{1-4}	$\alpha 2$	β_{1-4}		P _{2X2}
	Glu R3	NR2B	Glu R7	γ_{1-4}	$\alpha 3$	γ		P _{2X3}
	Glu R4	NR2C	KA1	δ	$\alpha 4$	δ		P _{2X4}
		NR2D	KA2	ϵ	β			P _{2X5}
				ρ_{1-3}				P _{2X6}
								P _{2X7}

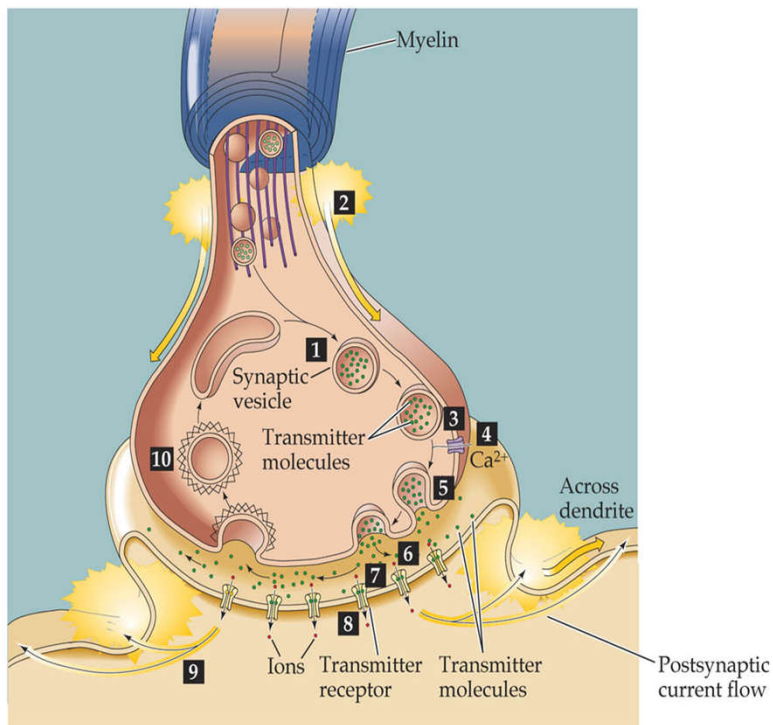
Excitatory & Inhibitory Currents



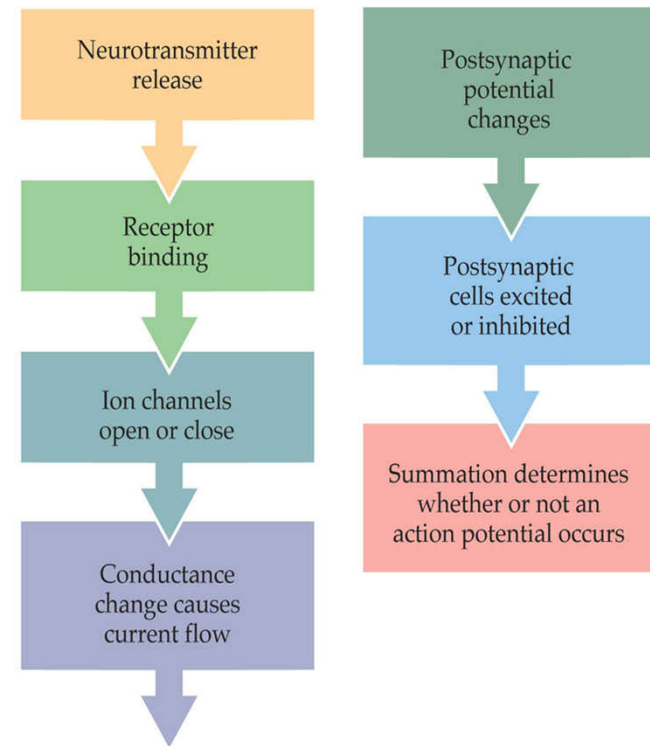
Excitatory & Inhibitory Currents



Excitatory & Inhibitory Currents

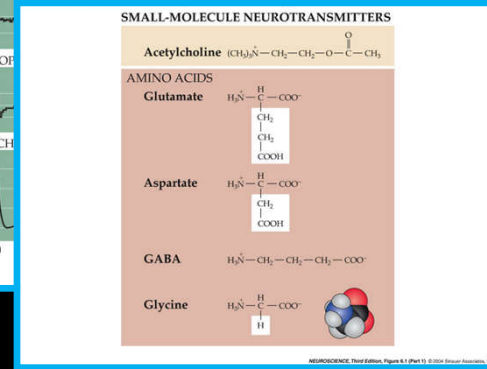
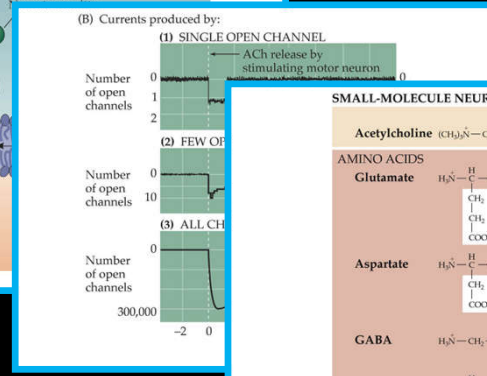
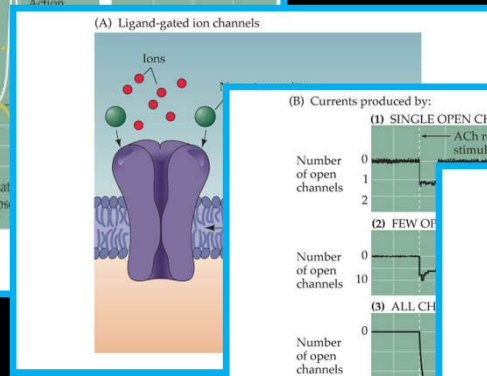
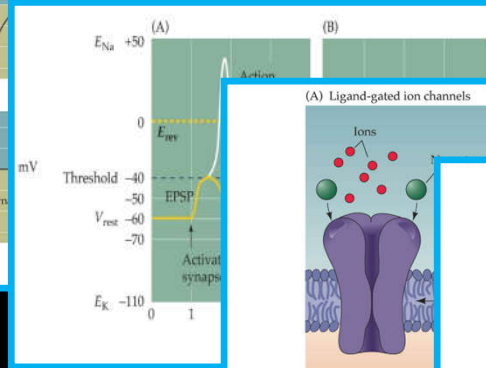
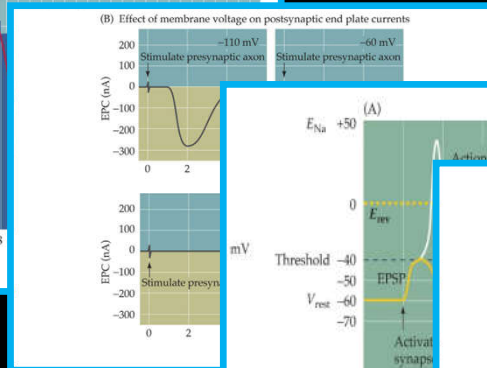
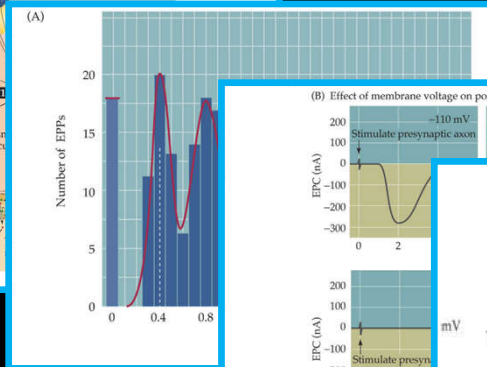
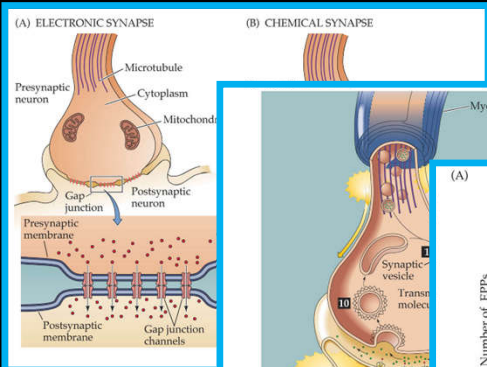


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Summary



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Na-K Gradients

Channels

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