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TIRIK ORGANIZMLARDA ELEKTR TOKI: MEXANIZMLARI, FIZIOLOGIK AHAMIYATI VA KLINIK QO‘LLANILISHI

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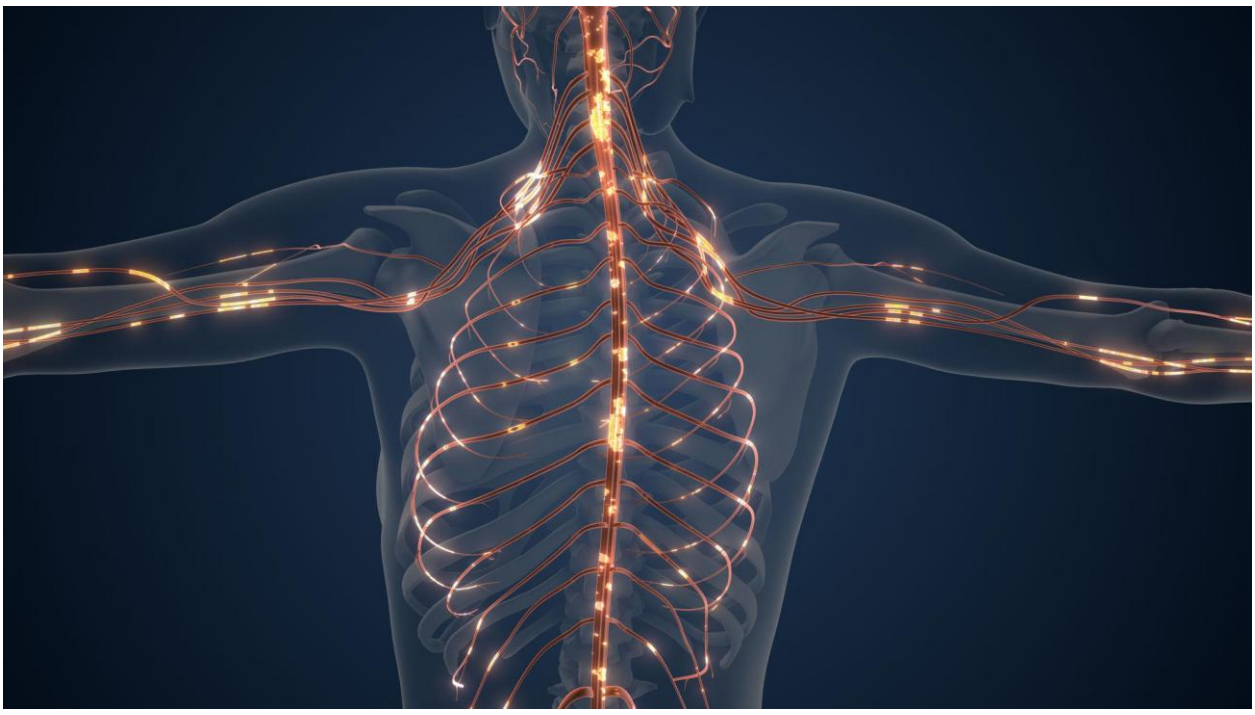
Eshmamatov Bobur Mamarasulovich

Annotatsiya

Tirik organizmlarda elektr toki — bioelektrik hodisalar — hujayra membranasi orqali ionlarning tartibli harakati natijasida yuzaga keladigan murakkab fiziologik jarayondir. Ushbu maqolada bioelektrik tokning paydo bo‘lish mexanizmlari, ion kanallari faoliyati, membrana potensiali va harakat potensiali chuqur tahlil qilinadi. Bundan tashqari, nerv tizimi, mushaklar va yurak faoliyatida elektr signallarning roli keng yoritiladi. Bioelektrik hodisalarning buzilishi natijasida yuzaga keladigan kasalliklar va ularning klinik diagnostikadagi ahamiyati ham muhokama qilinadi. Maqola IMRAD strukturasida yozilgan bo‘lib, ilmiy va insoniy tushunarli uslubda bayon etilgan.

Kalit so‘zlar: bioelektrik, elektrofiziologiya, membrana potensiali, harakat potensiali, ion kanallari, nerv impulsi



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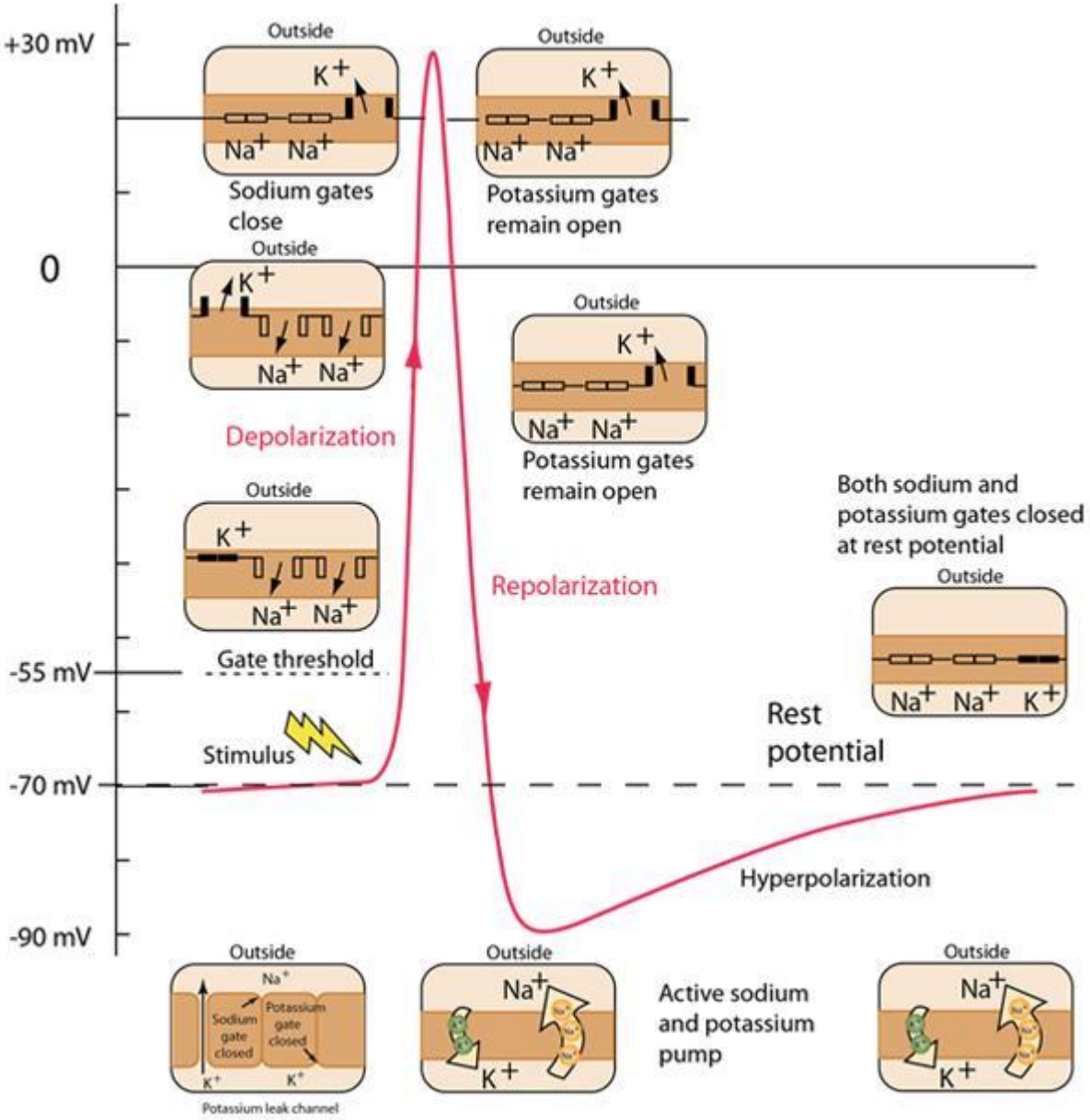

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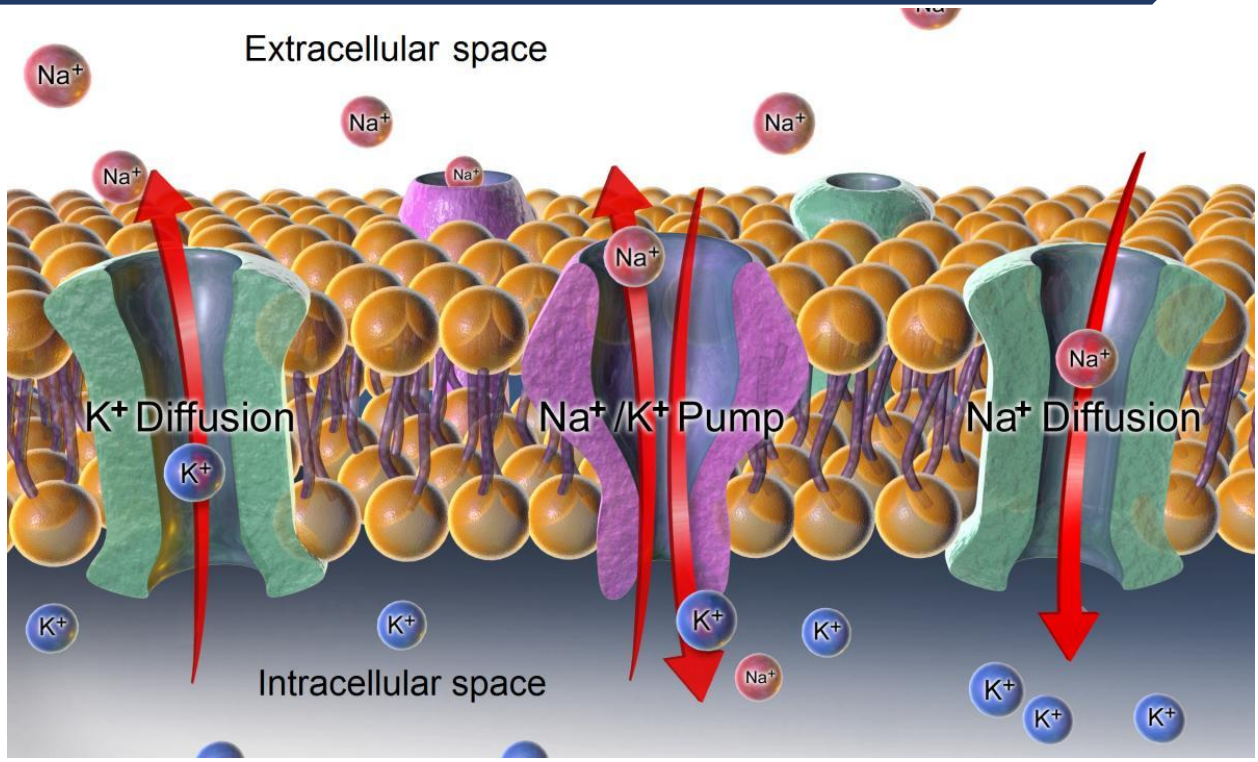

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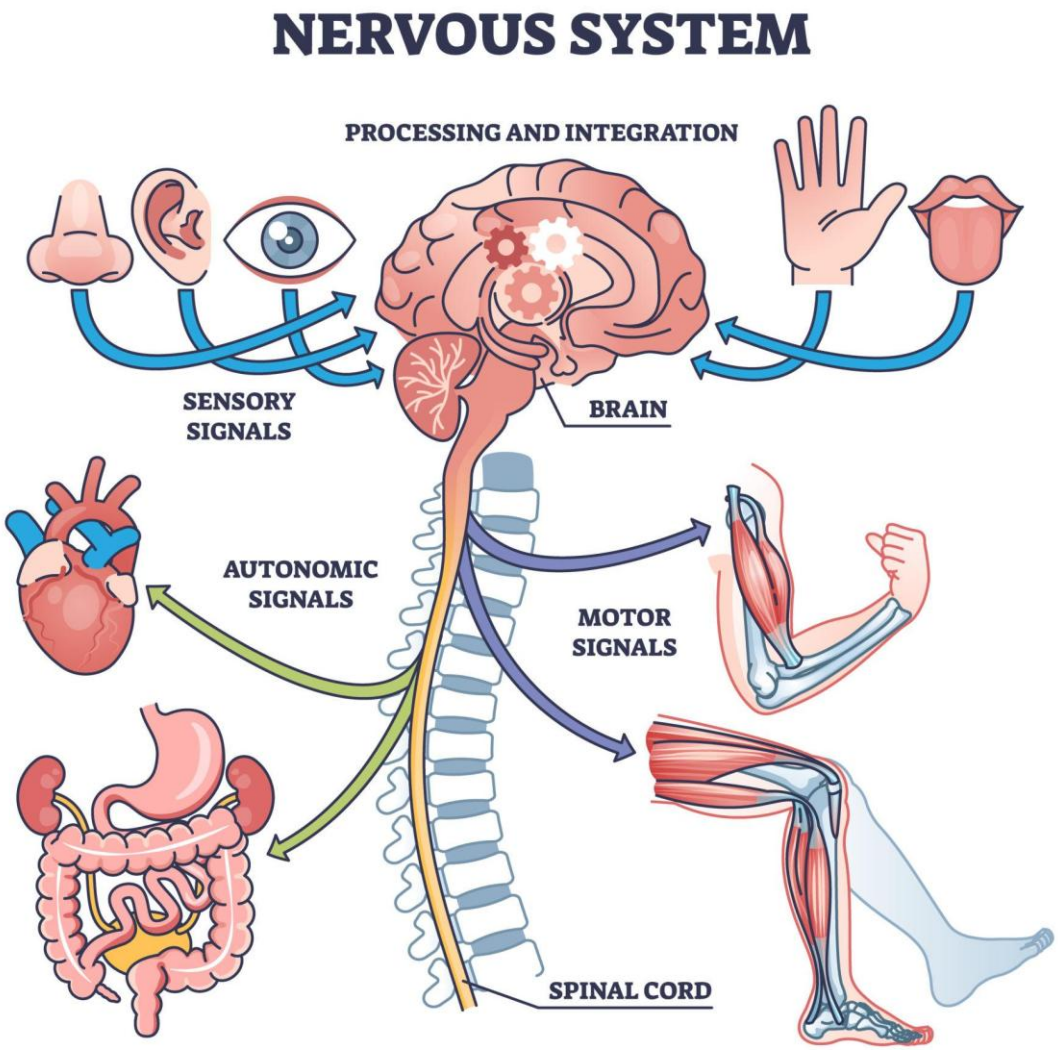

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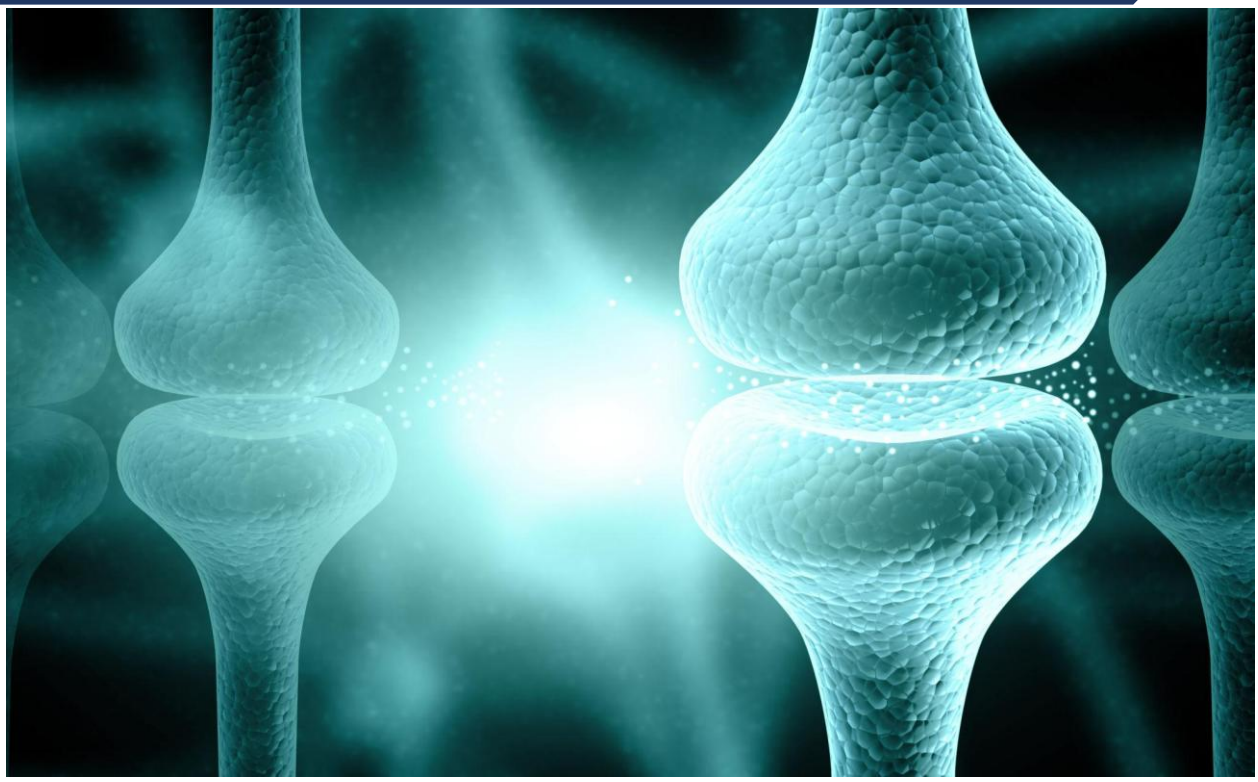
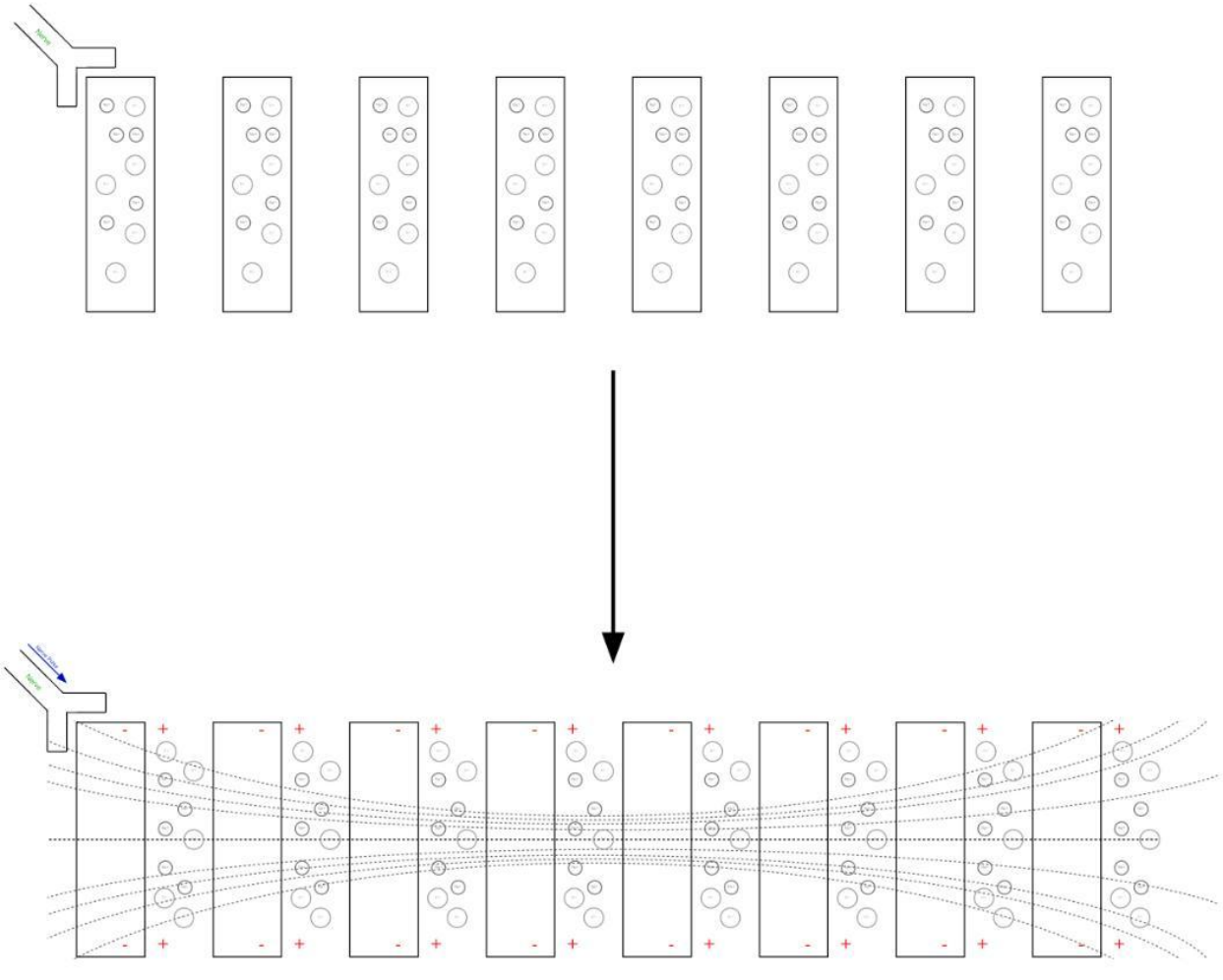
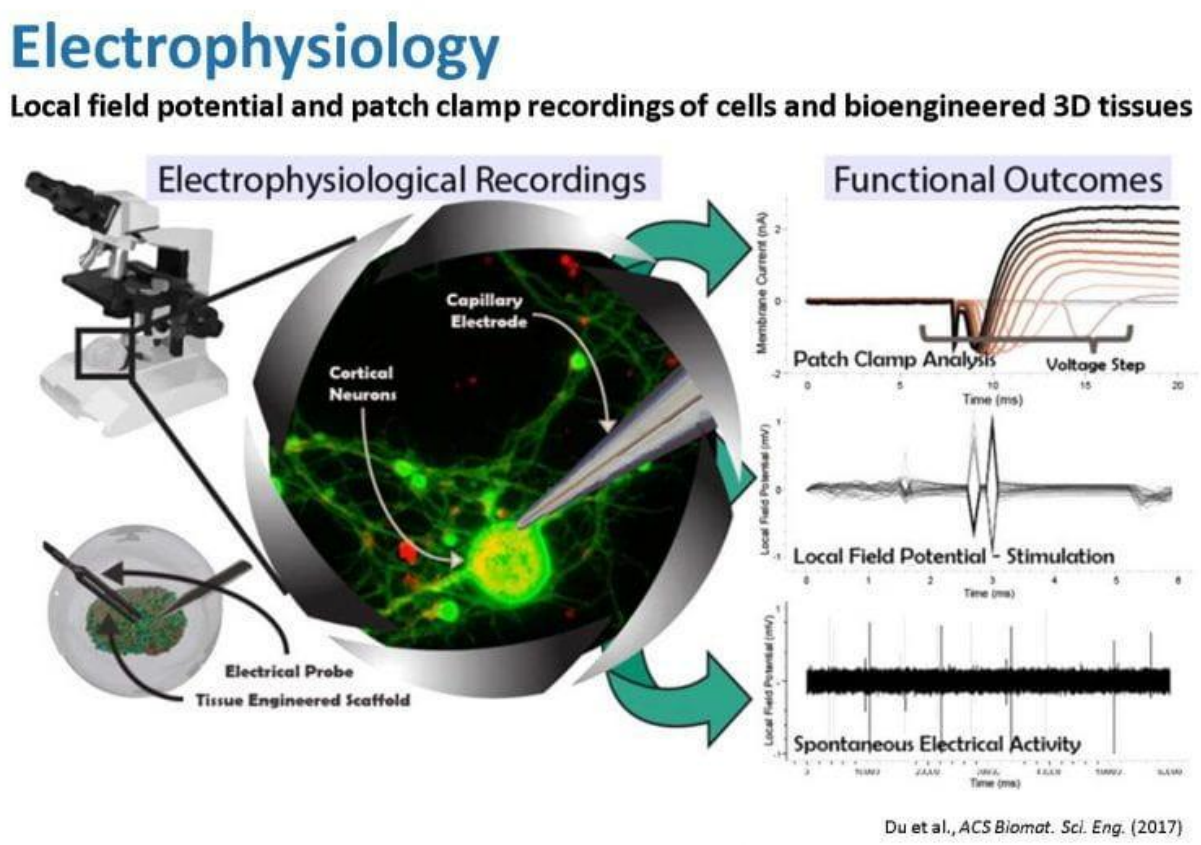






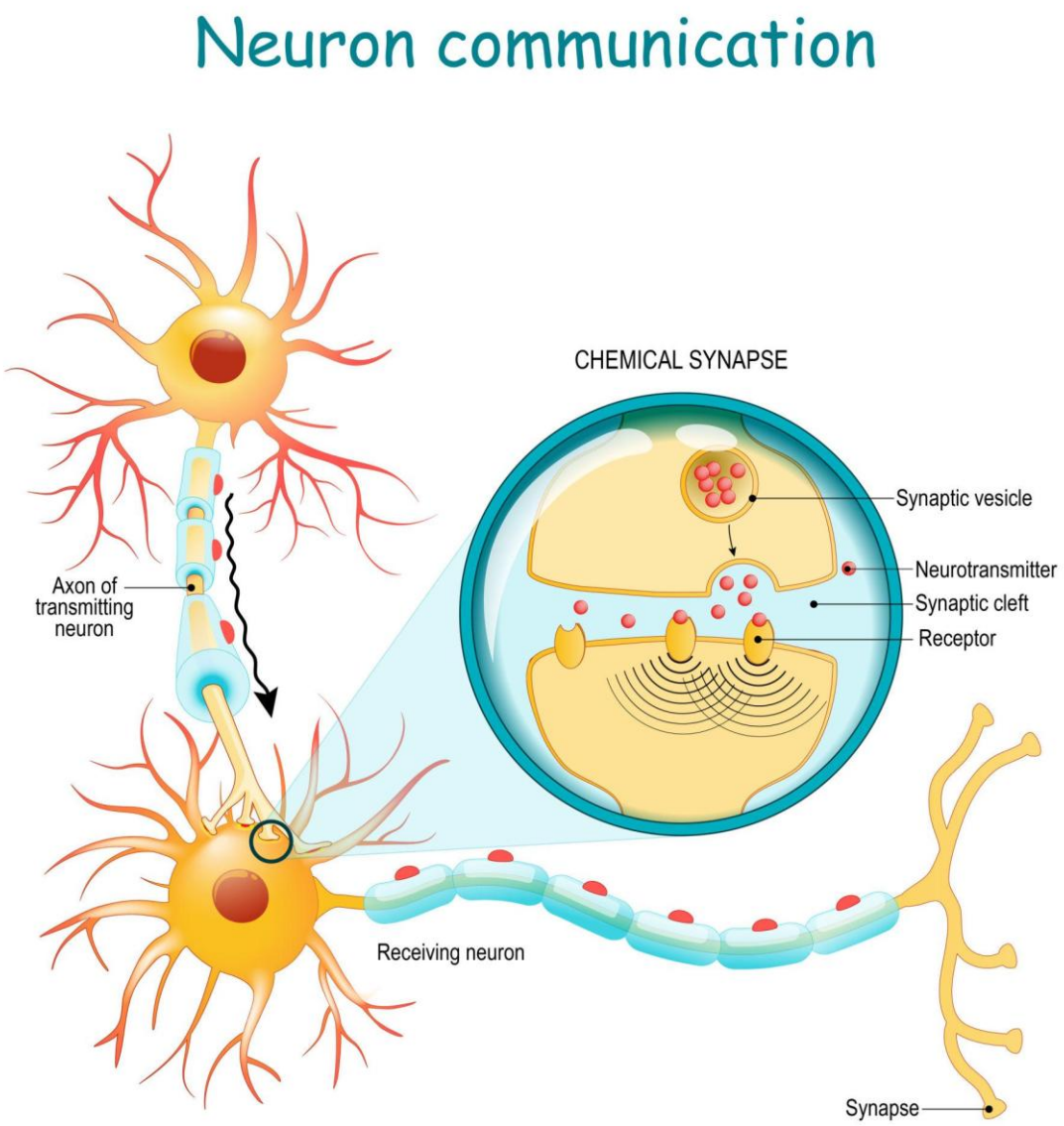
Kirish

Tirik organizmlar faoliyati uzluksiz davom etuvchi biofizik va biokimyoviy jarayonlarga asoslanadi. Shulardan eng muhimlaridan biri — bu bioelektrik hodisalardir. Elektr toki inson organizmida doimiy ravishda mavjud bo‘lib, u hujayralararo aloqa, reflekslar, mushak qisqarishi va yurak ritmini boshqarishda muhim rol o‘ynaydi.

Oddiy misol sifatida, qo‘lni harakatlantirish yoki yurakning urishi tashqi tomondan mexanik jarayon bo‘lib ko‘rinsa-da, aslida bu jarayonlarning asosida elektr signallar yotadi. Bu signallar ionlarning (natriy, kaliy, kalsiy va xlor) hujayra membranasi orqali o‘tishi bilan yuzaga keladi.

Bioelektrik hodisalarni chuqur o‘rganish nafaqat nazariy jihatdan, balki amaliy tibbiyotda ham katta ahamiyatga ega. Masalan, yurak faoliyatini baholash uchun EKG, miya faoliyatini o‘rganish uchun EEG, mushak faoliyatini tekshirish uchun EMG usullari qo‘llaniladi.

Materiallar va usullar



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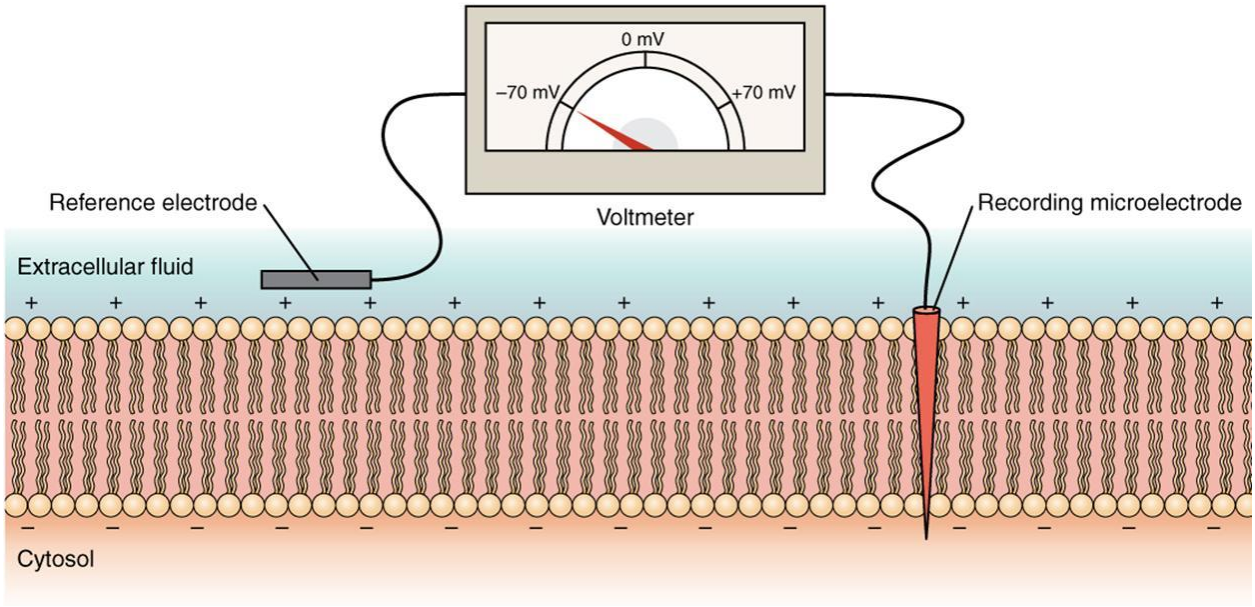

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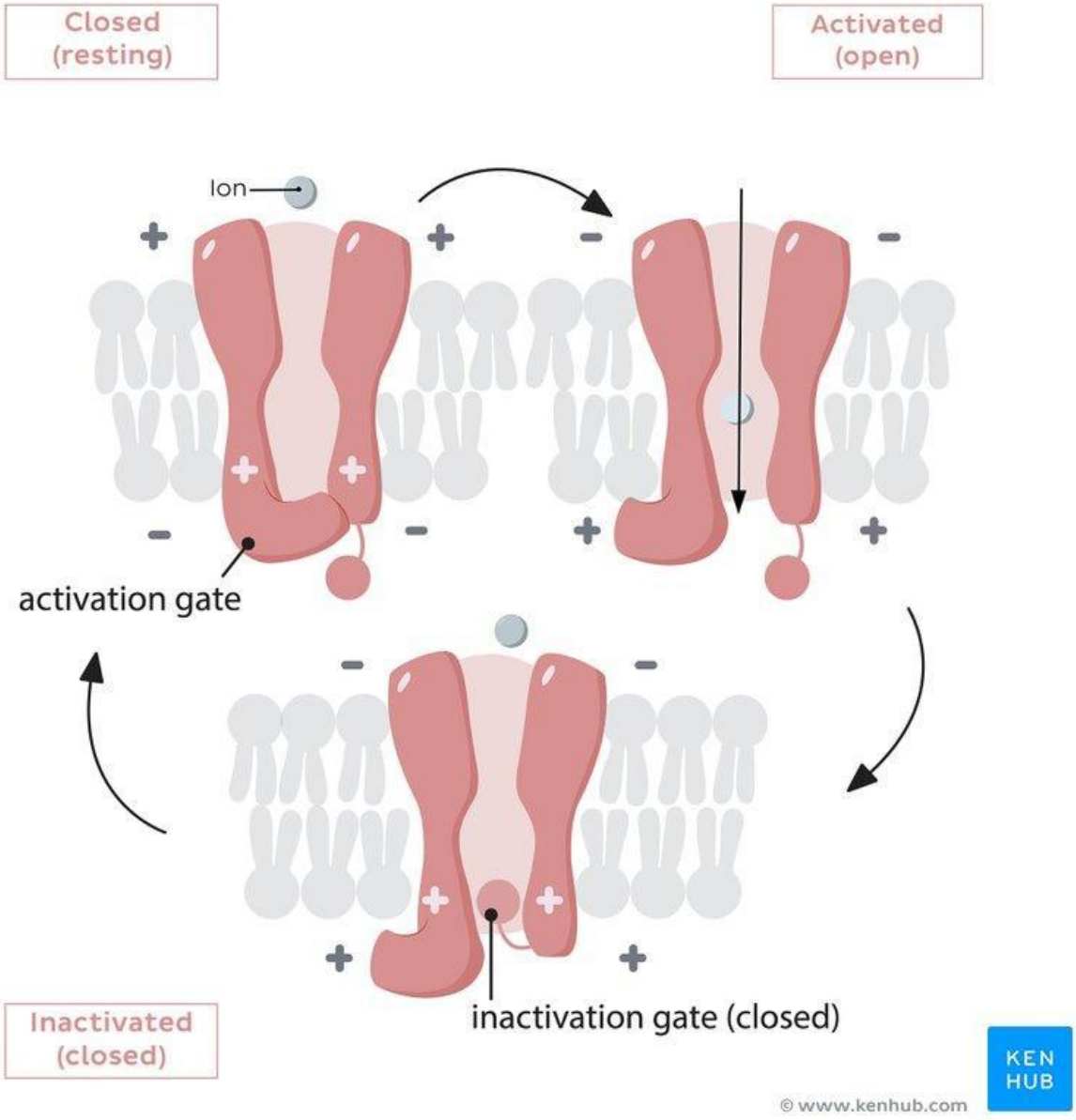
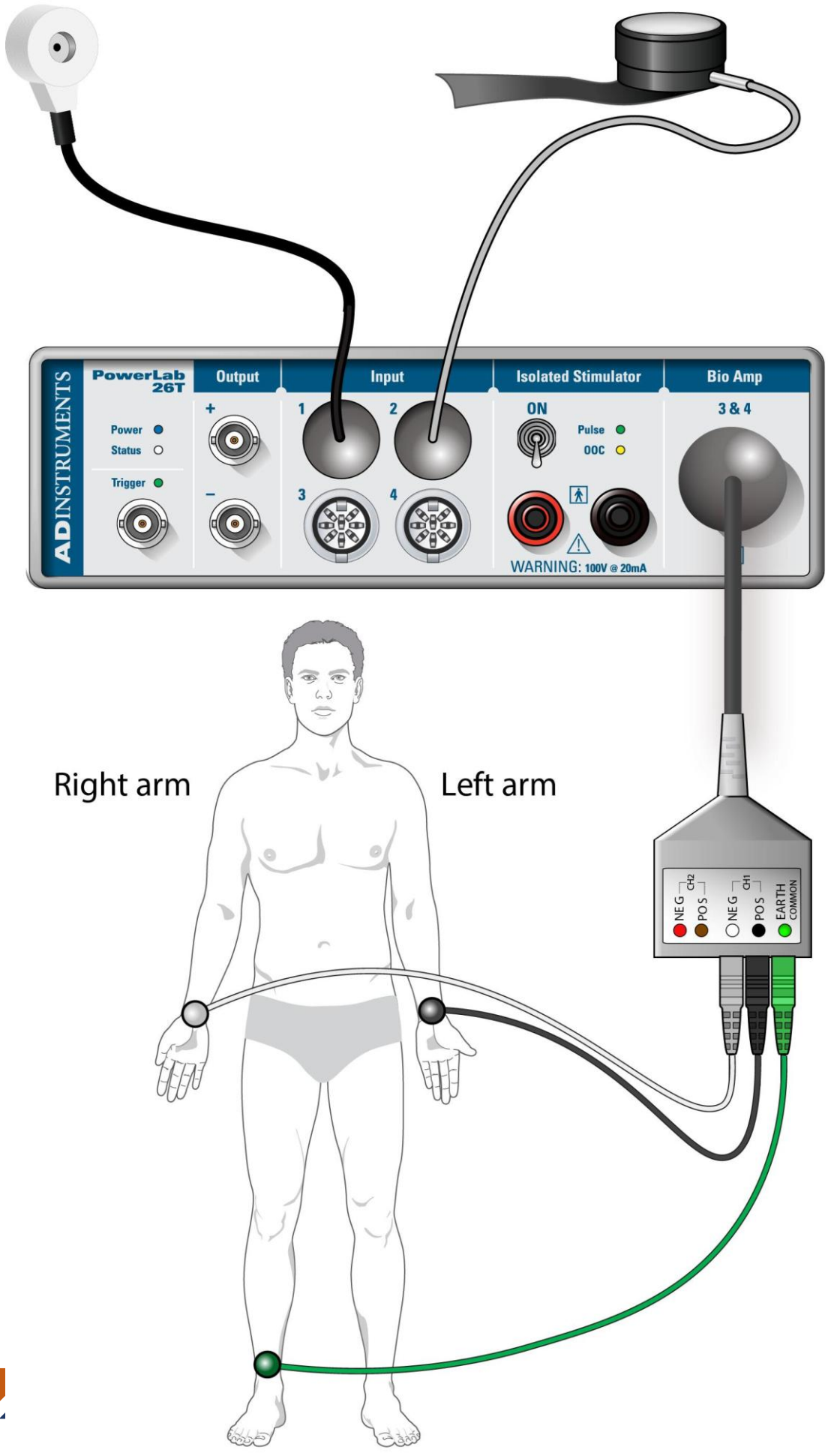
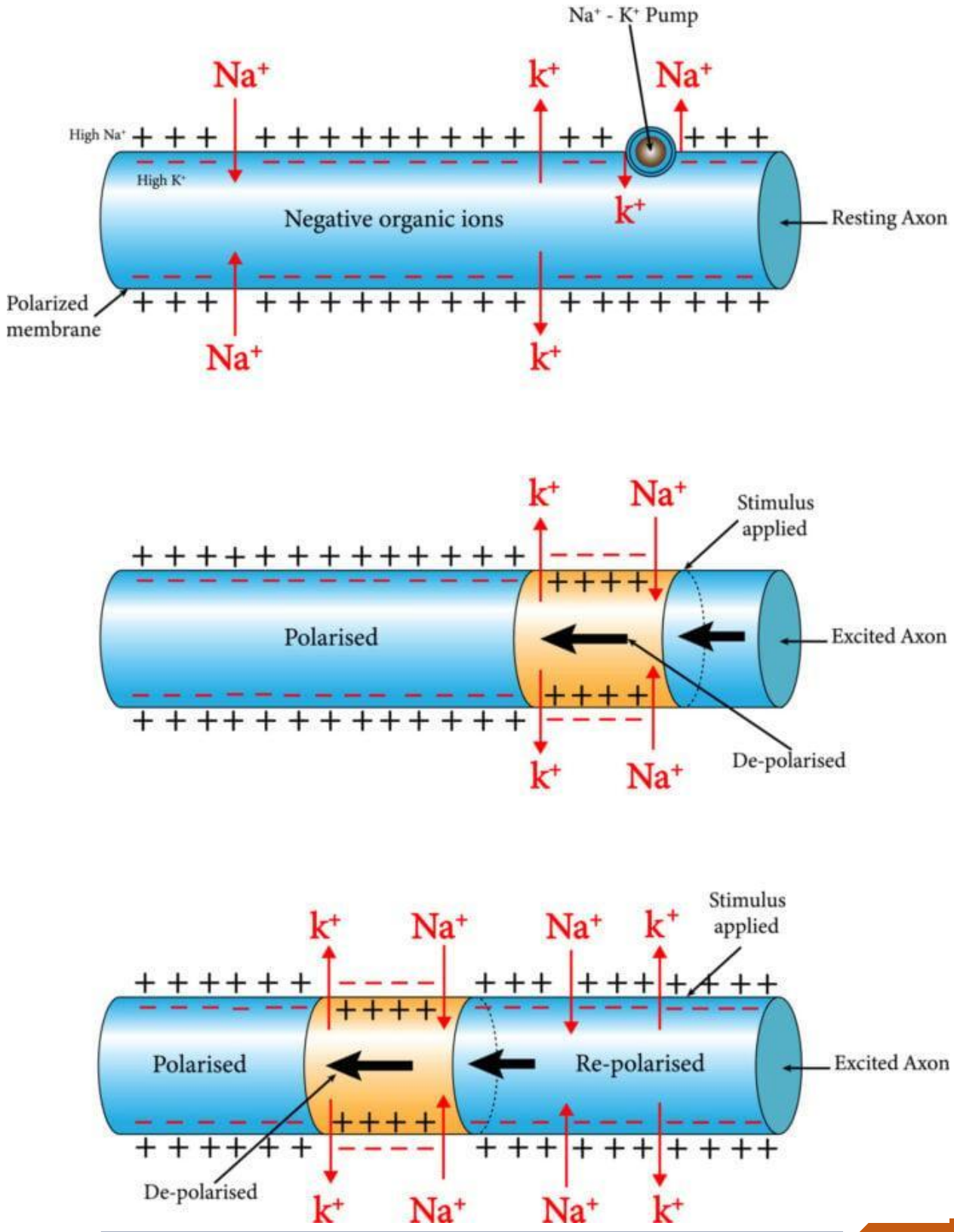



ADINSTRUMENTS
PowerLab 26T
Output
Input
Isolated Stimulator
Bio Amp
Power
Status
Trigger
+
–
1
2
3
4
ON
Pulse
OOC
3 & 4
WARNING: 100V @ 20mA
Right arm
Left arm
NEG
POS
CH2
NEG
POS
CH1
EARTH
COMMON

Conduction of nerve impulse



Ushbu maqola ilmiy adabiyotlar tahliliga asoslangan nazariy ish hisoblanadi.

Manbalar:

- Zamonaviy fiziologiya va biofizika darsliklari
- PubMed, Scopus bazalaridagi ilmiy maqolalar
- Klinik elektrofiziologiya qo‘llanmalari

Usullar:

- Analitik va sintez usuli
- Taqqoslash (nerv, mushak va yurak faoliyatini solishtirish)
- Diagrammalar asosida tushuntirish

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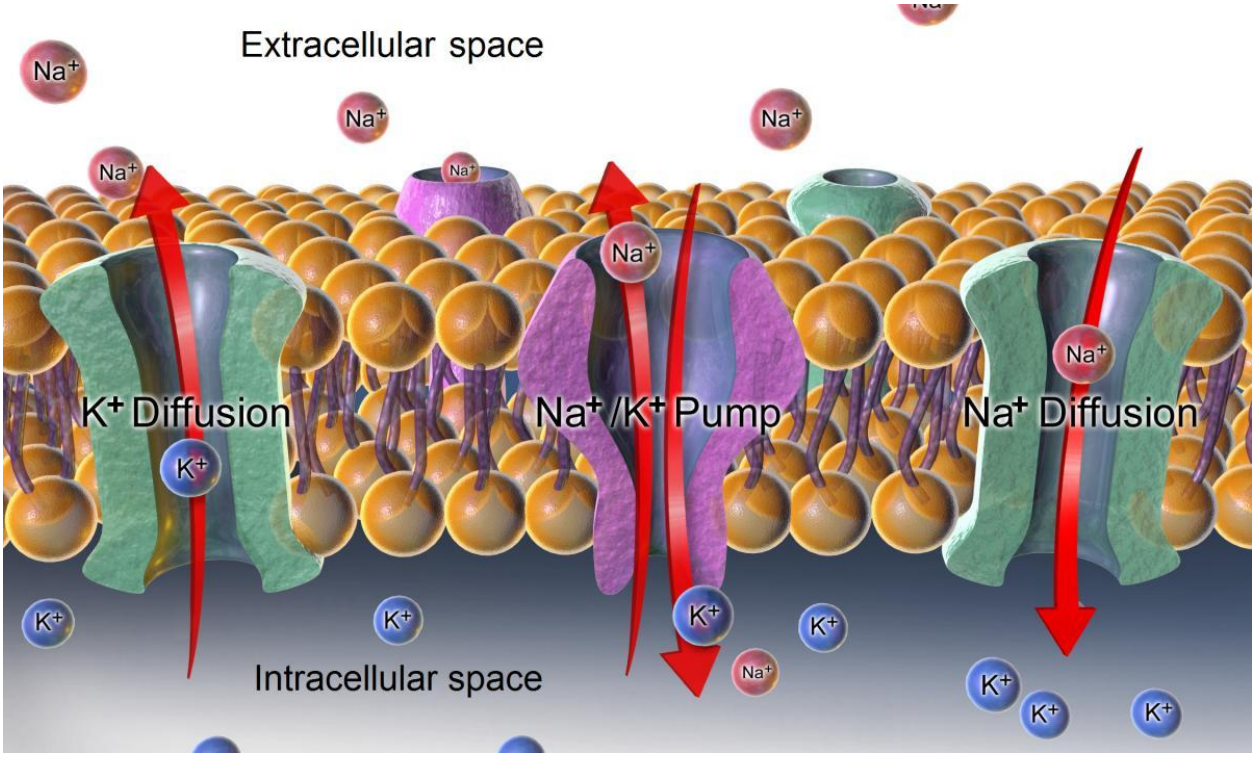
Natijalar

1. Hujayra membranasi va ionlar harakati



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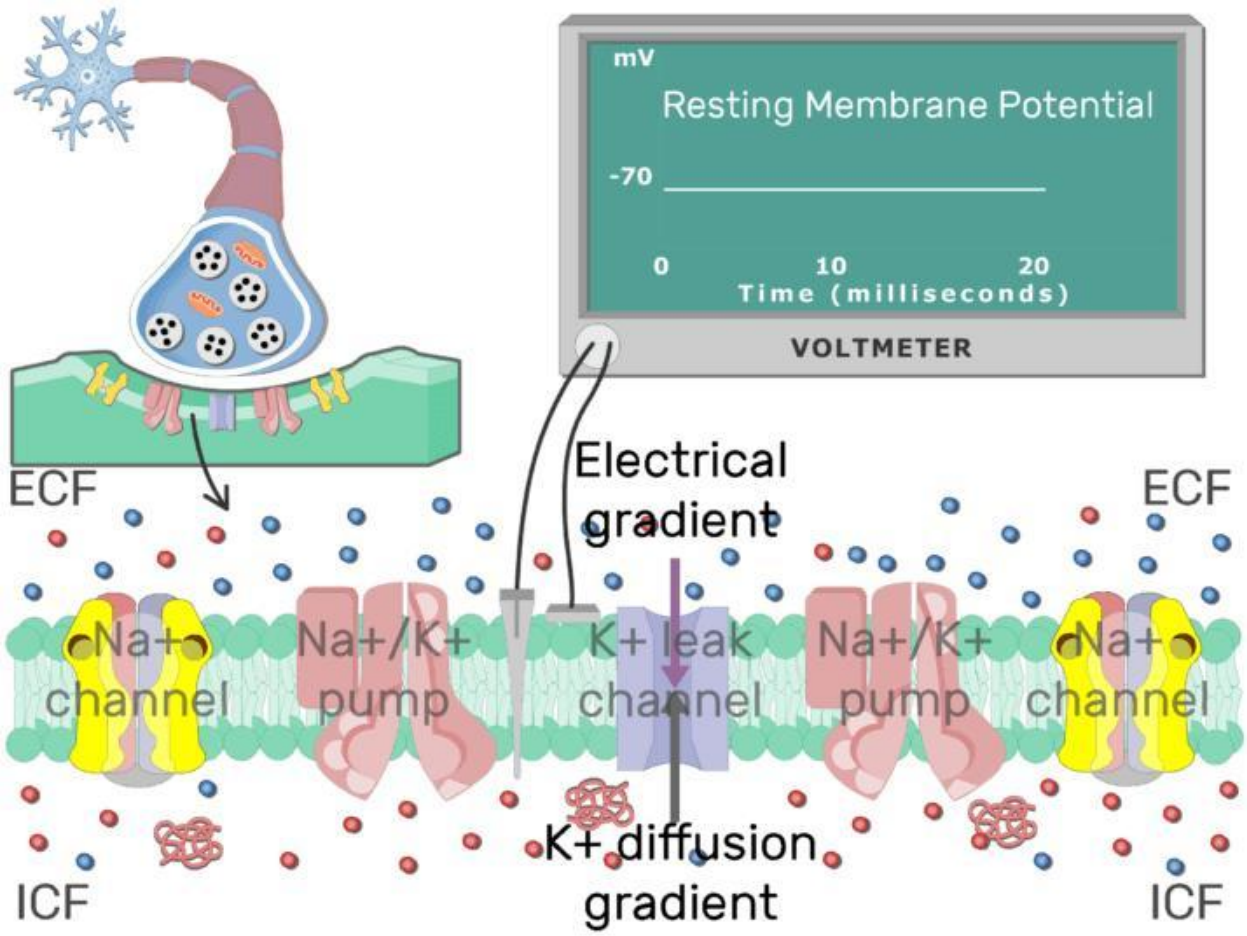

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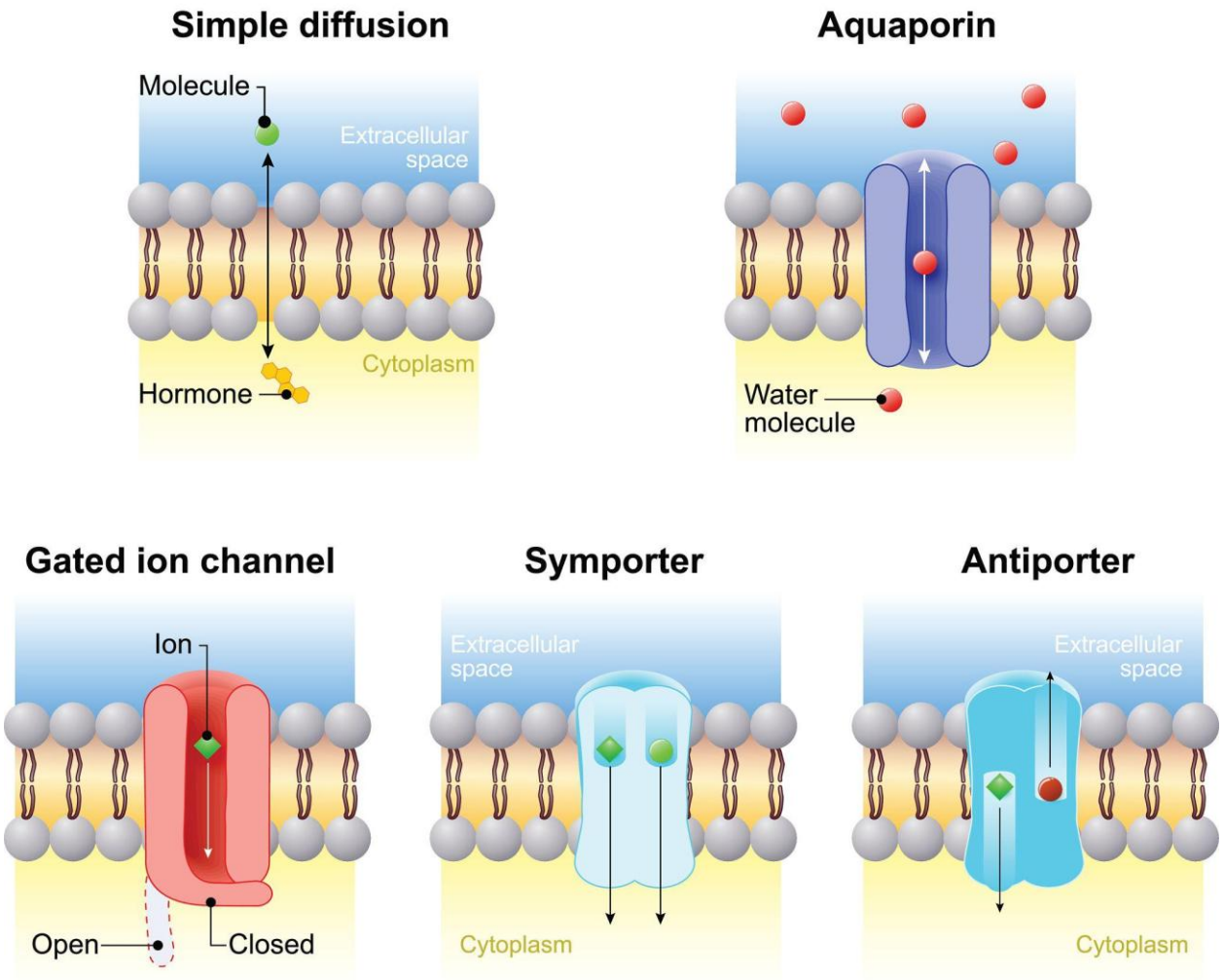
Membrane transporters



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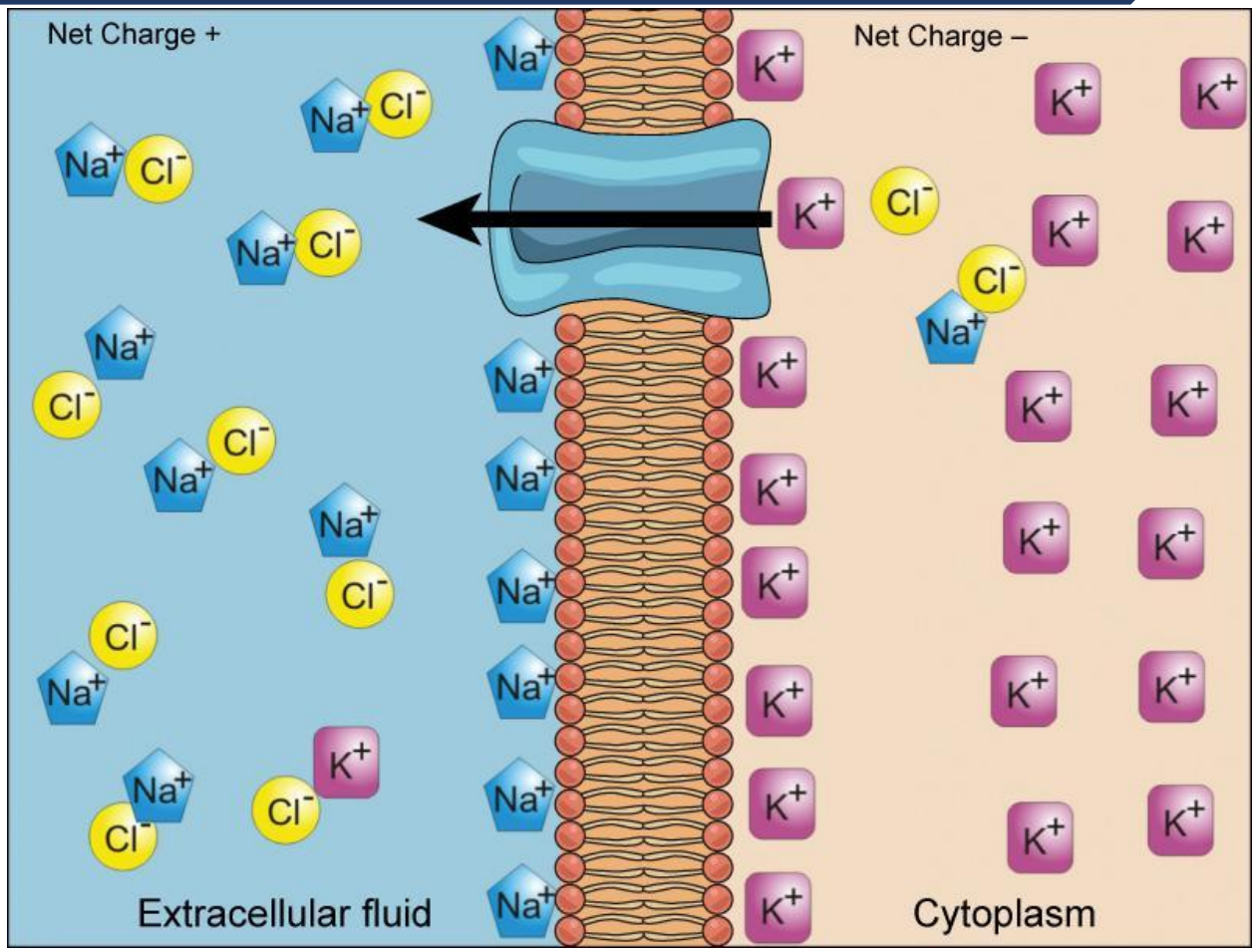

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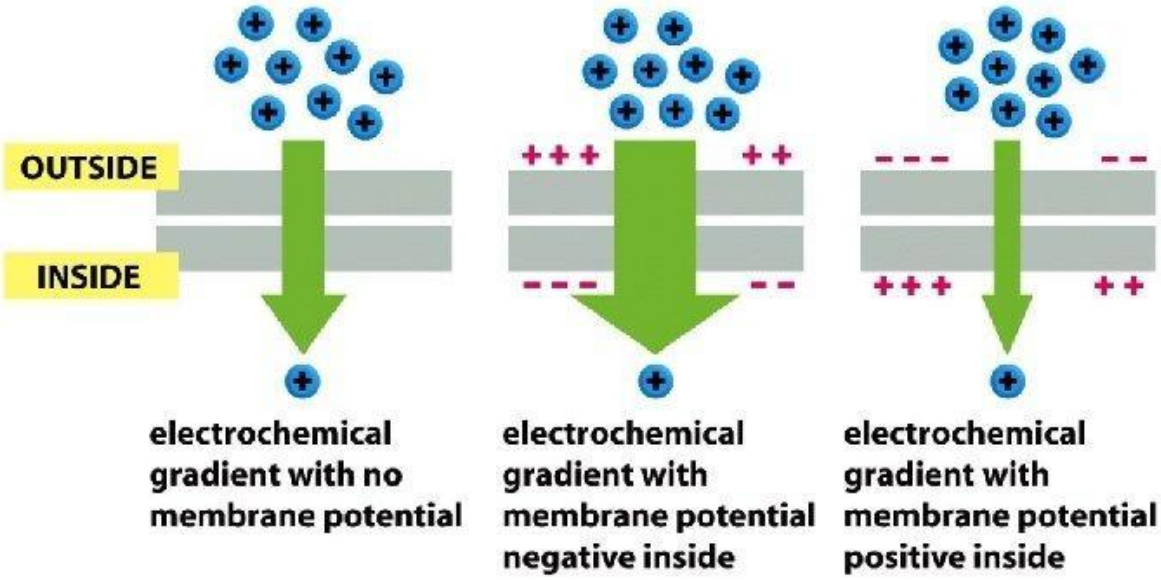
An electrochemical gradient combines the membrane potential and the concentration gradient



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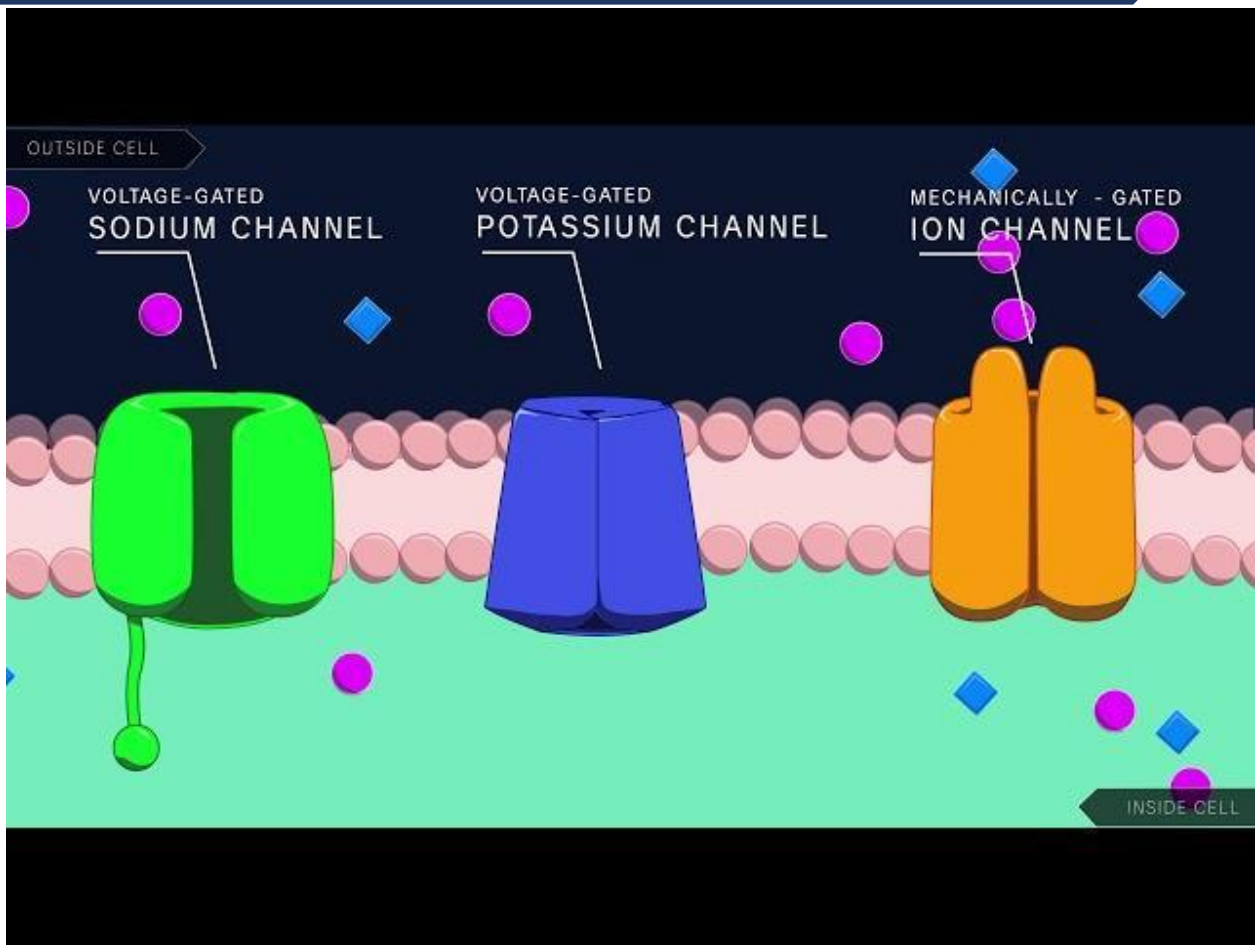
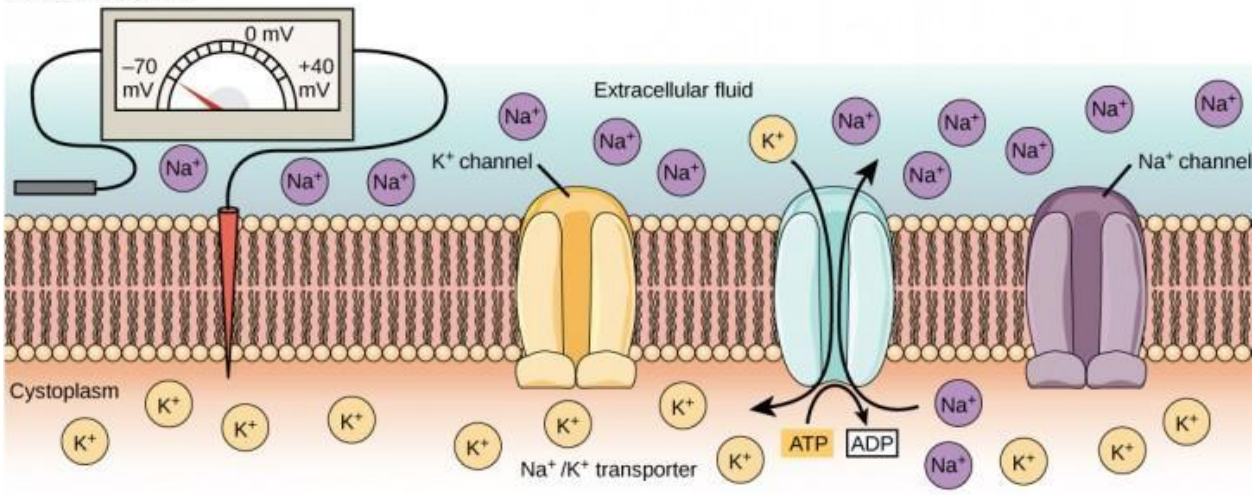
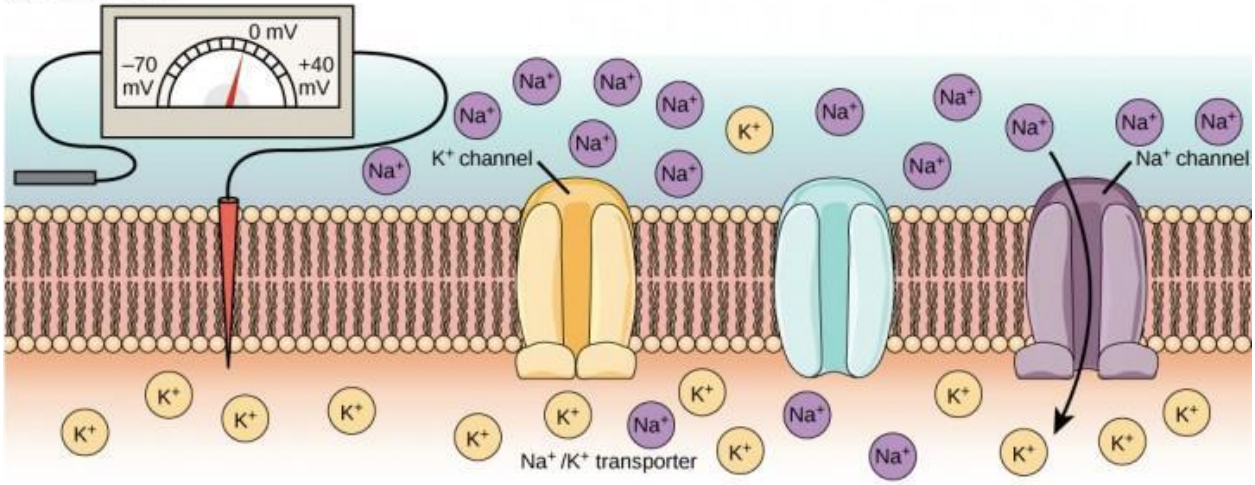


(a) Resting potential



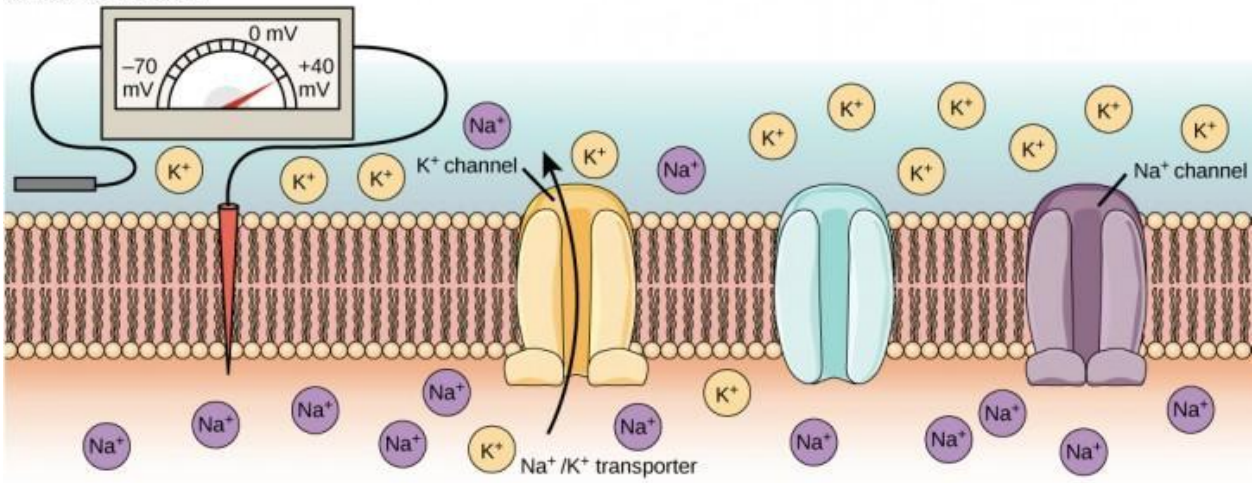
At the resting potential, all voltage-gated Na^+ channels and most voltage-gated K^+ channels are closed. The Na^+/K^+ transporter pumps K^+ ions into the cell and Na^+ ions out.

(b) Depolarization



In response to a depolarization, some Na^+ channels open, allowing Na^+ ions to enter the cell. The membrane starts to depolarize (the charge across the membrane lessens). If the threshold of excitation is reached, all the Na^+ channels open.

(c) Hyperpolarization



At the peak action potential, Na^+ channels close while K^+ channels open. K^+ leaves the cell, and the membrane eventually becomes hyperpolarized.

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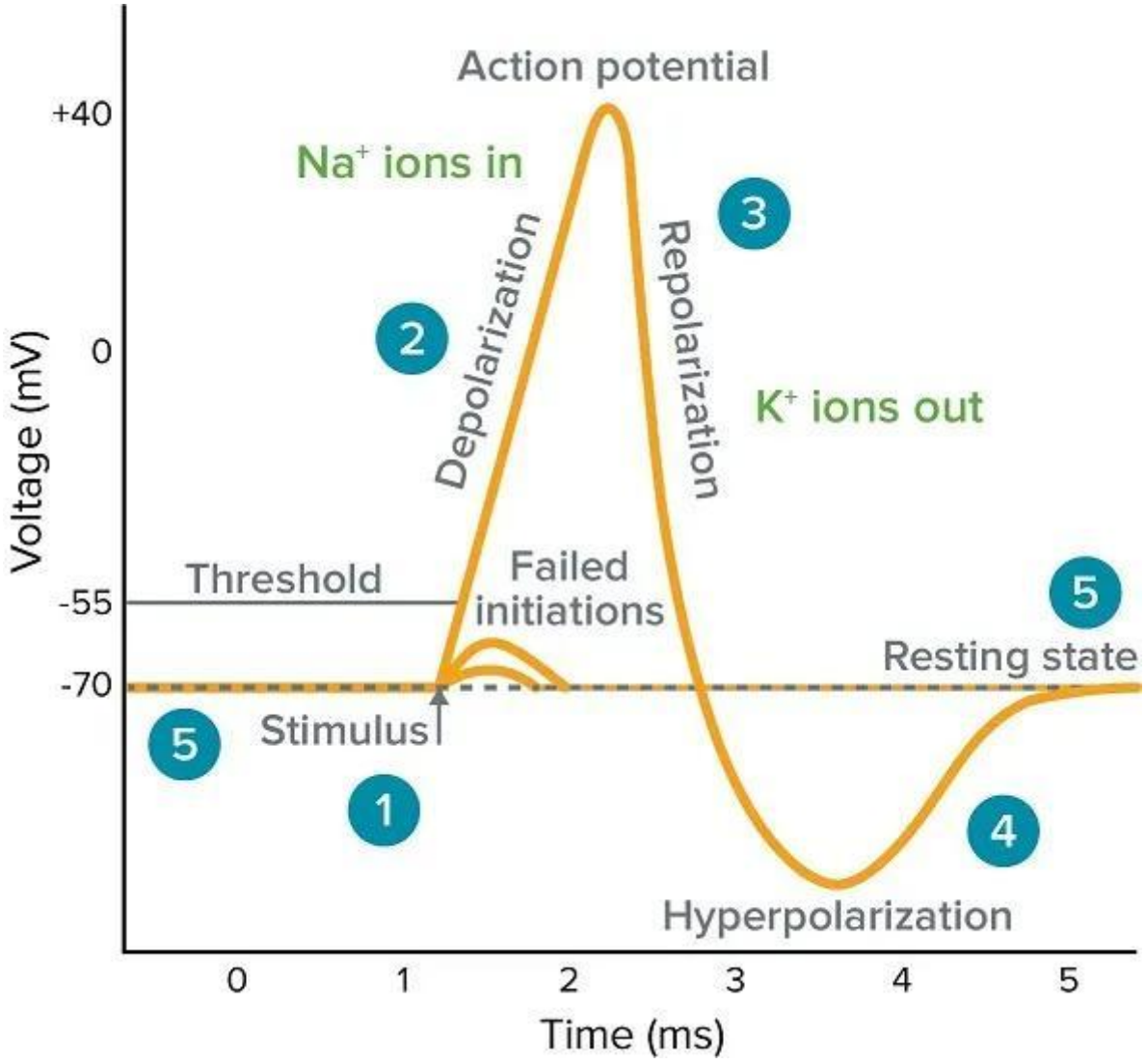
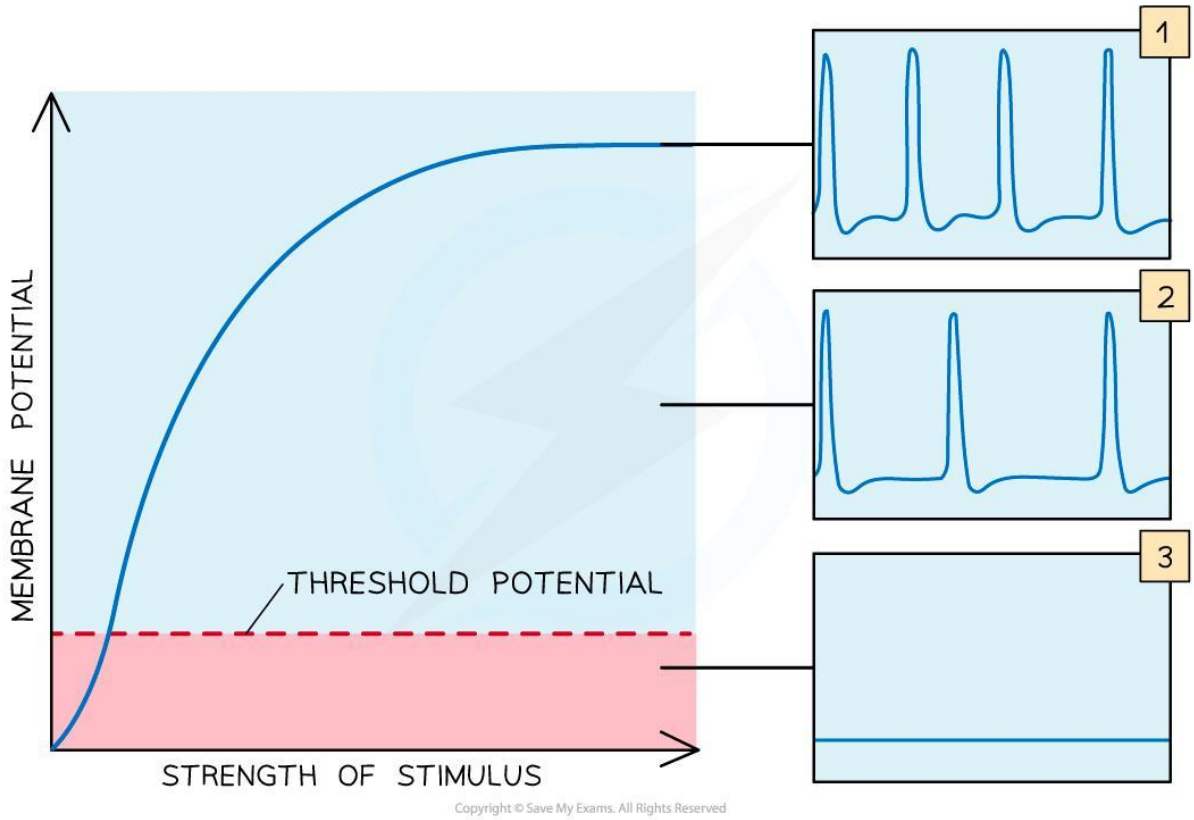
Hujayra membranasi yarim o‘tkazuvchan tuzilma bo‘lib, ionlar harakatini boshqaradi.

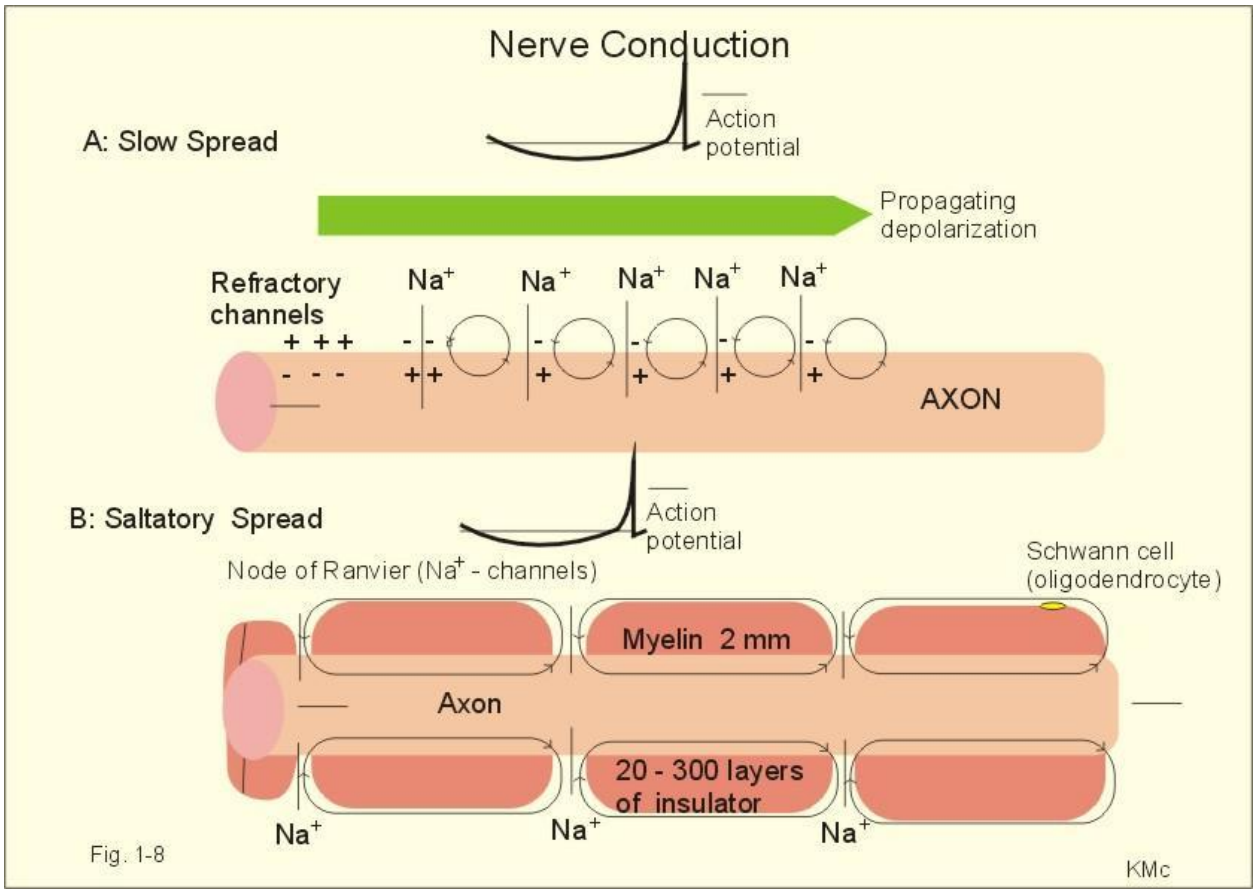
Asosiy ionlar: **Na^+, K^+, Ca^{2+}, Cl^-**

- Natriy-kaliy nasosi (Na^+/K^+ pumpa) energiya sarflab ionlarni tashiydi
- Konsentratsiya gradienti va elektr gradient mavjud
- Bu gradientlar bioelektrik potensialni hosil qiladi

2. Membrana potensiali va harakat potensiali







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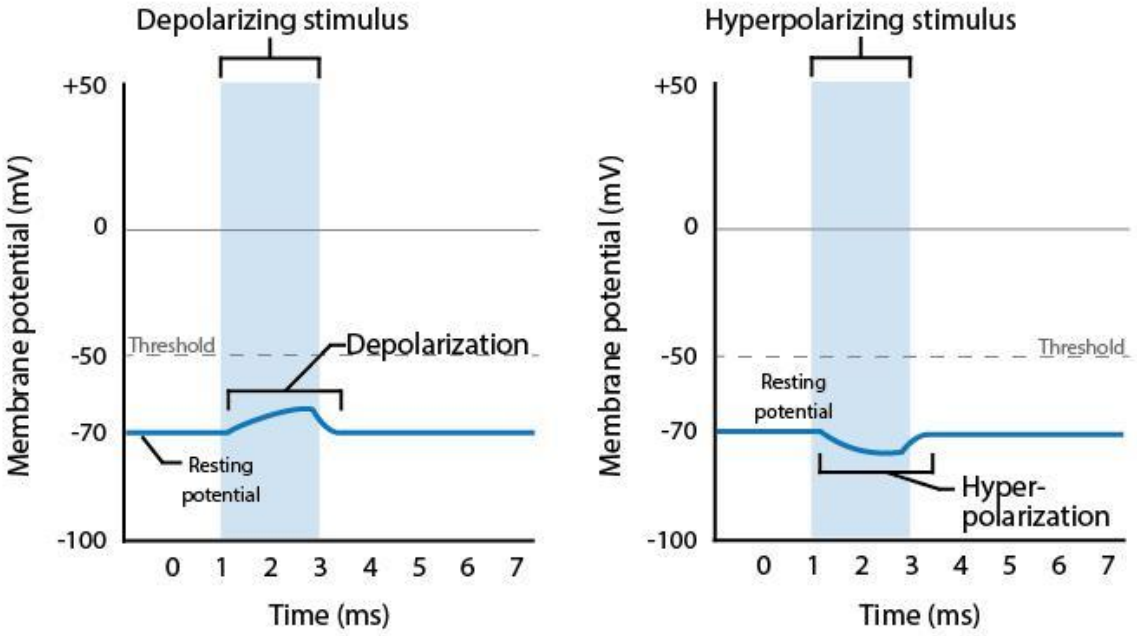

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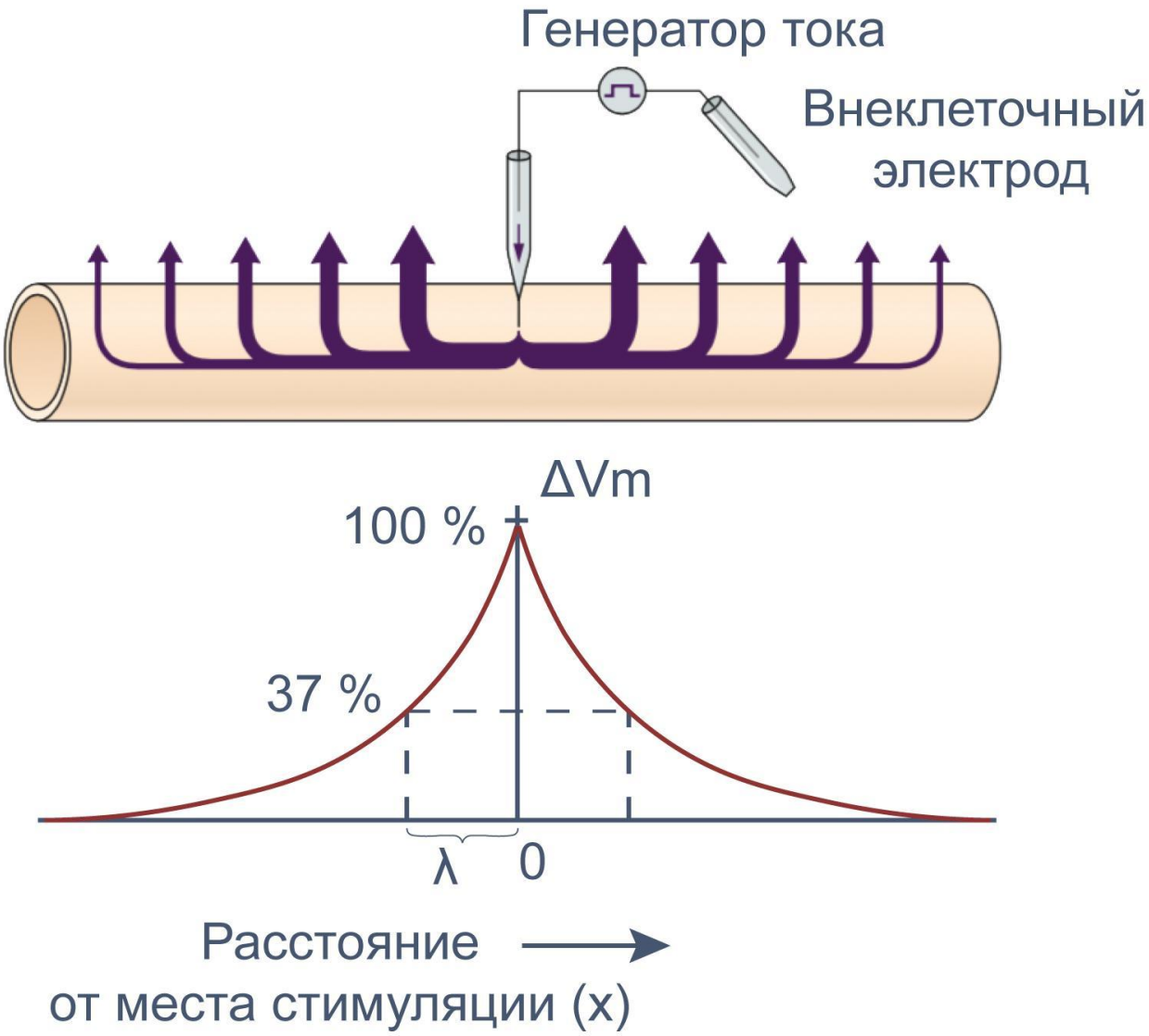
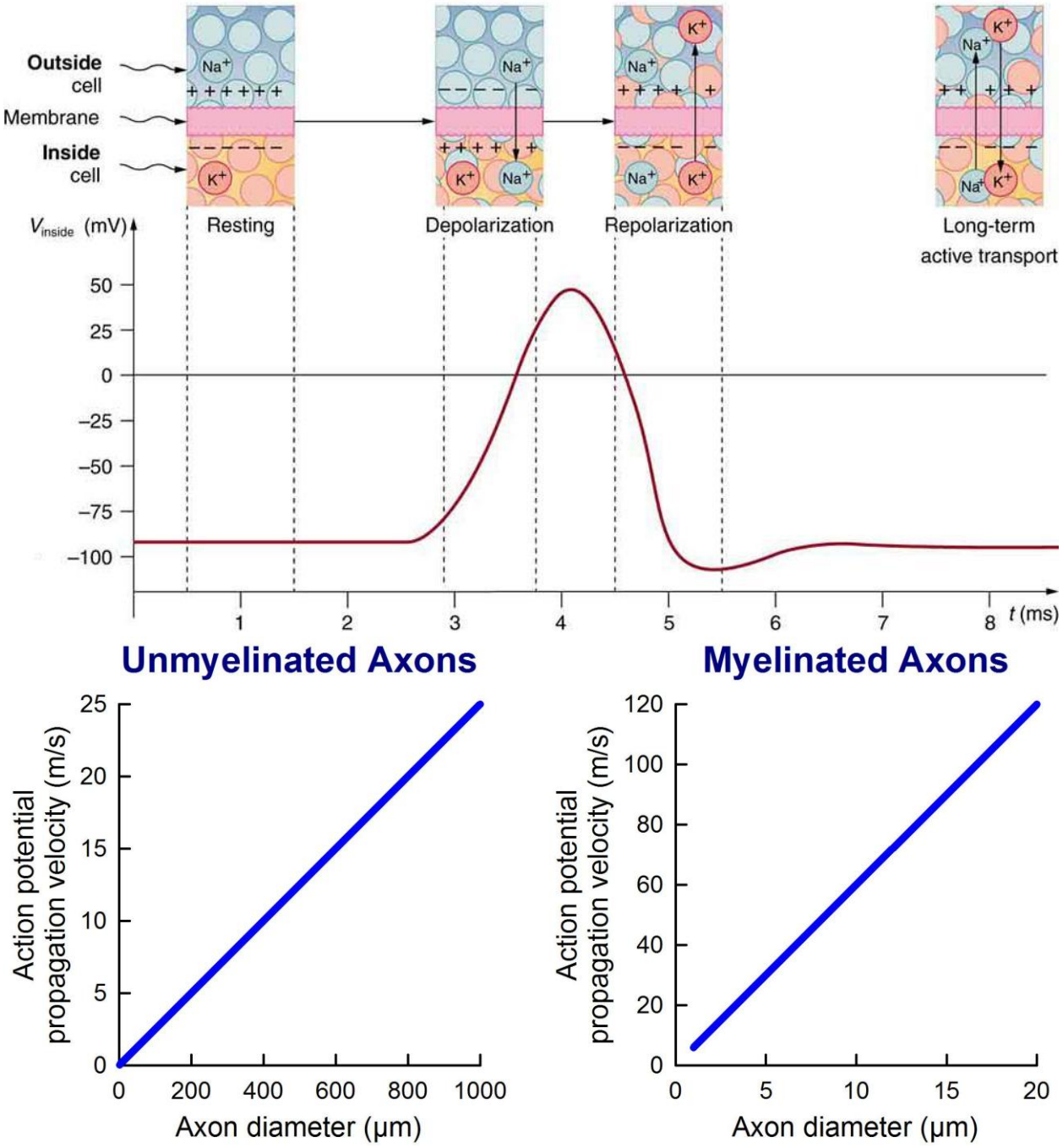




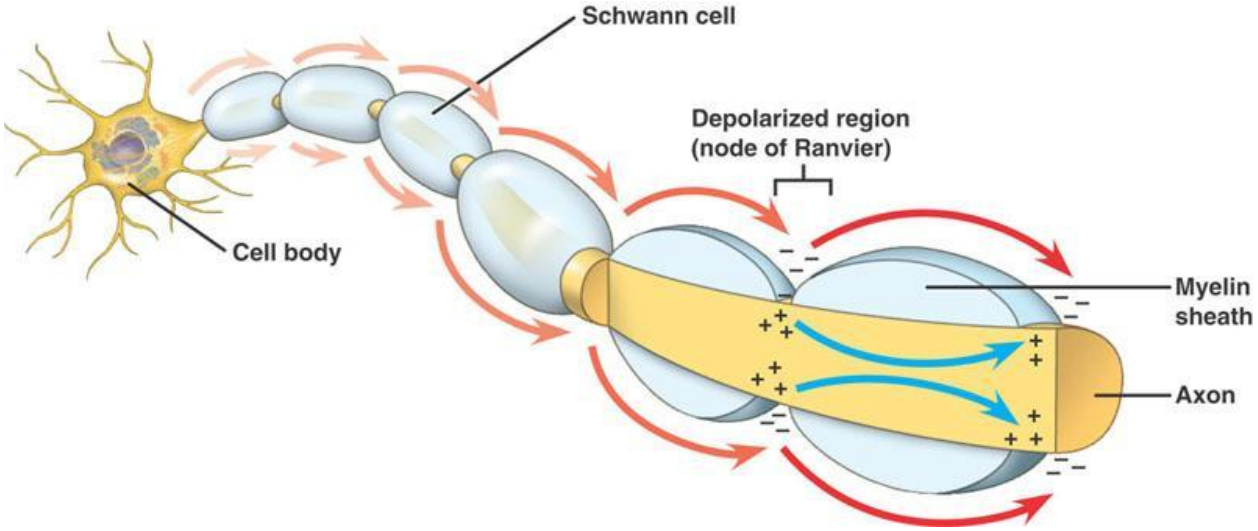
Membrana potensiali — hujayra ichki va tashqi muhit o‘rtasidagi elektr zaryad farqi.

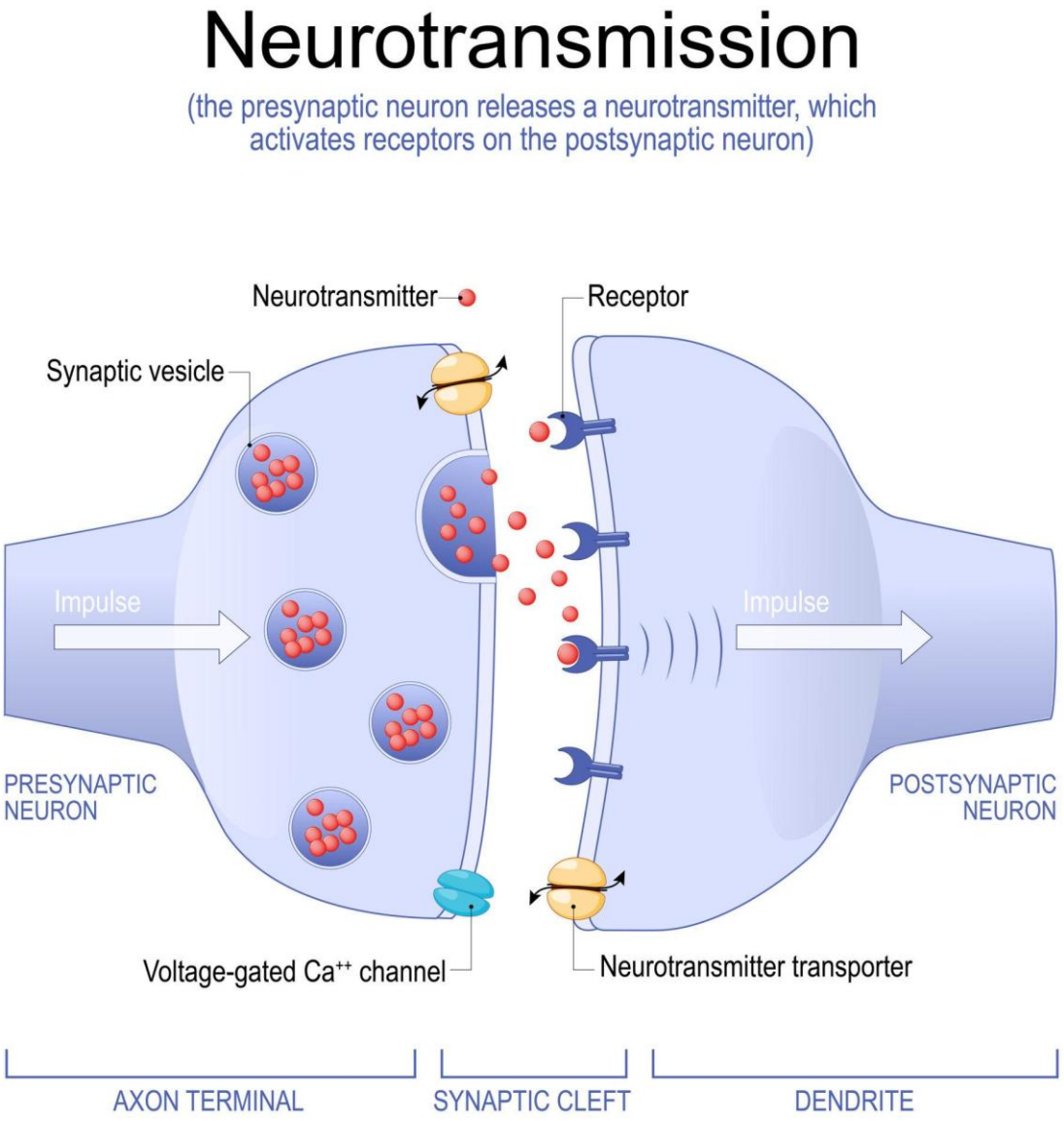
Bosqichlar:

- Tinchlik potensiali: -70 mV
- Depolyarizatsiya: Na^+ ichkariga kiradi
- Repolyarizatsiya: K^+ tashqariga chiqadi
- Giperpolyarizatsiya

Natijada **harakat potensiali** hosil bo‘ladi — bu nerv impulsining asosidir.

3. Nerv tizimida elektr tok




Neurotransmission
(the presynaptic neuron releases a neurotransmitter, which activates receptors on the postsynaptic neuron)
Neurotransmitter
Receptor
Synaptic vesicle
Impulse
Impulse
PRESYNAPTIC NEURON
POSTSYNAPTIC NEURON
Voltage-gated Ca++ channel
Neurotransmitter transporter
AXON TERMINAL
SYNAPTIC CLEFT
DENDRITE

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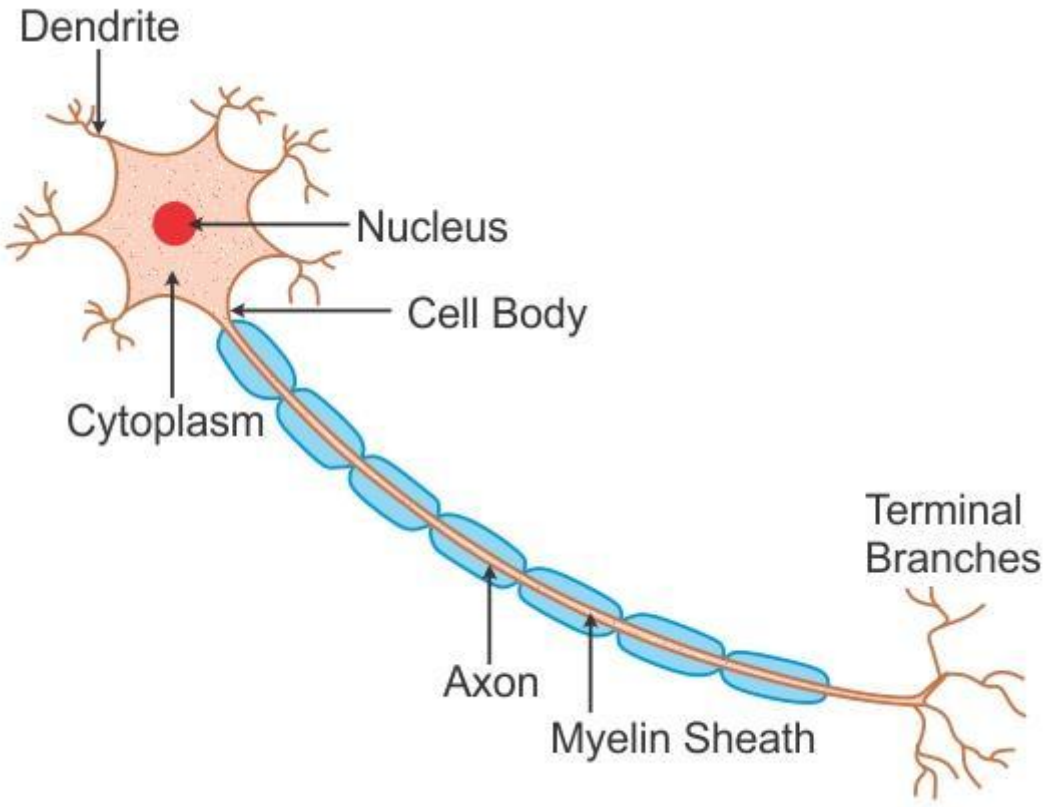
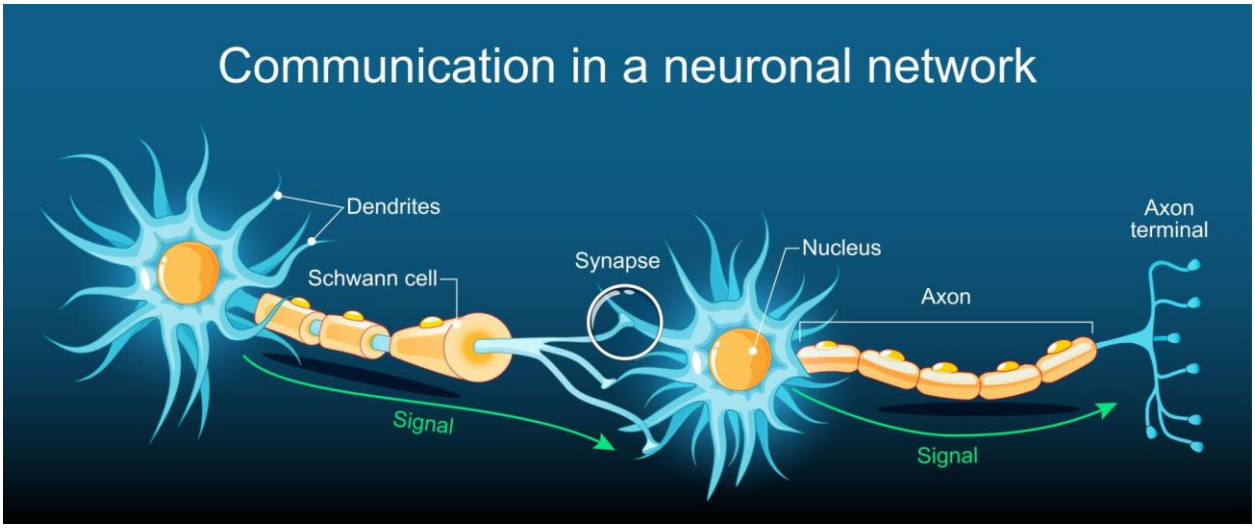
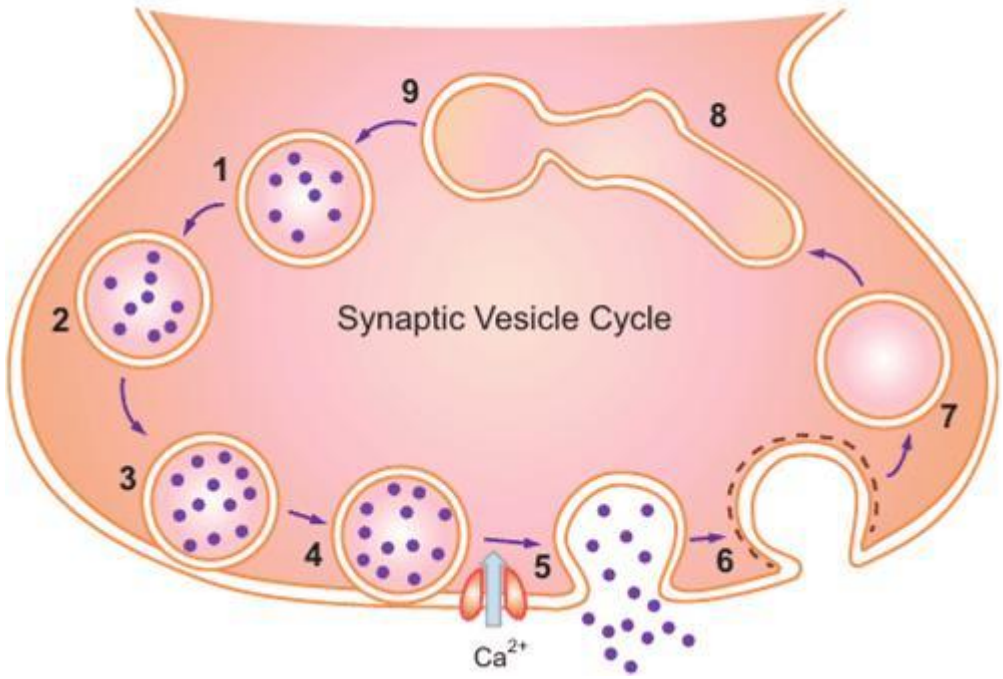
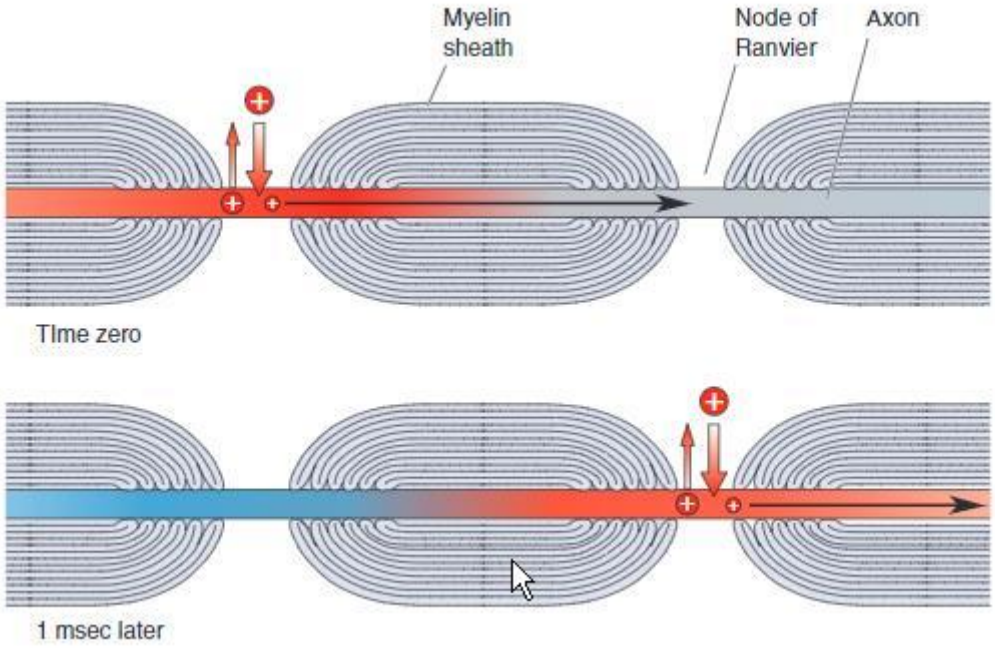


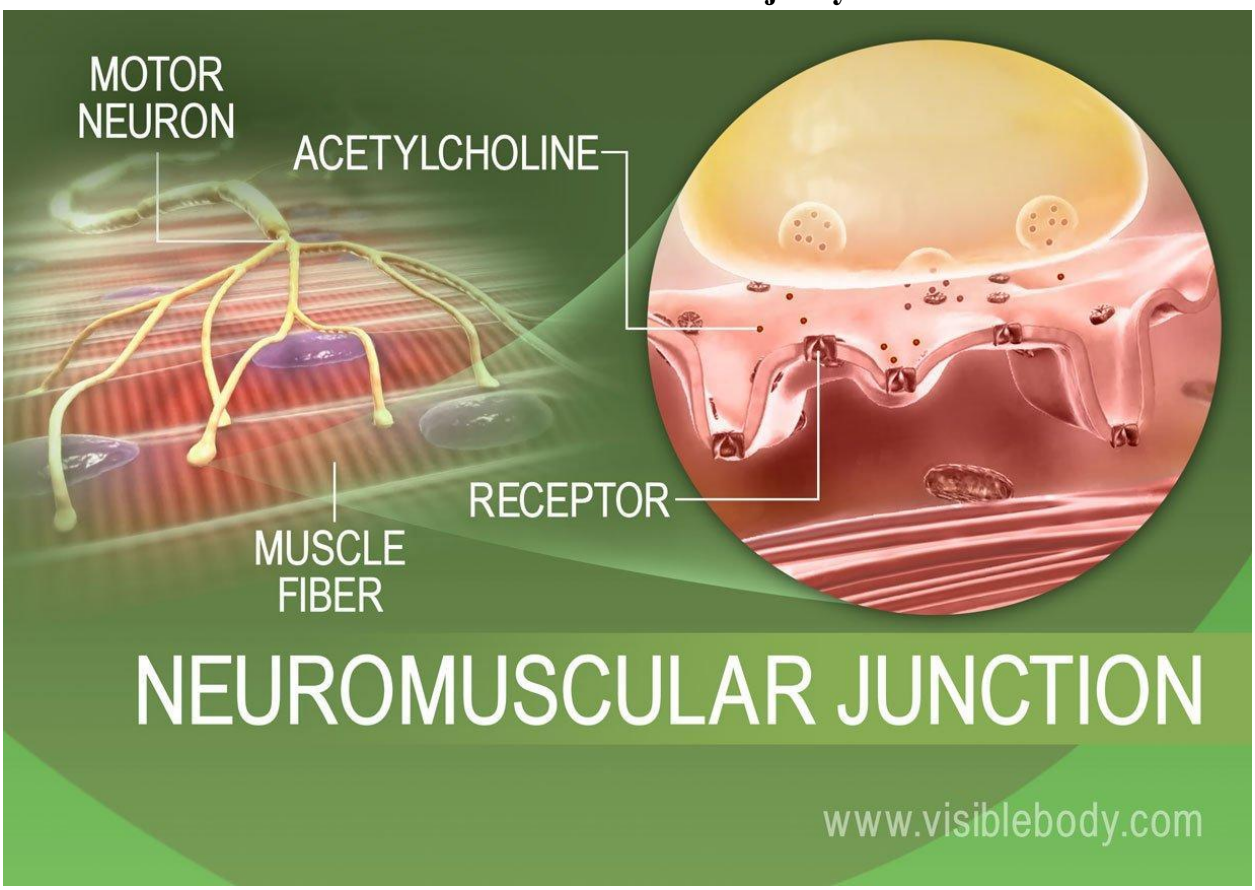






- Impuls akson bo‘ylab tarqaladi
- Miyelin qavati signal tezligini oshiradi (saltator o‘tish)
- Sinapslarda elektr signal → kimyoviy signalga aylanadi
- Neyromediatorlar (asetilxolin va boshqalar) ishtirok etadi

4. Mushaklarda bioelektrik jarayonlar



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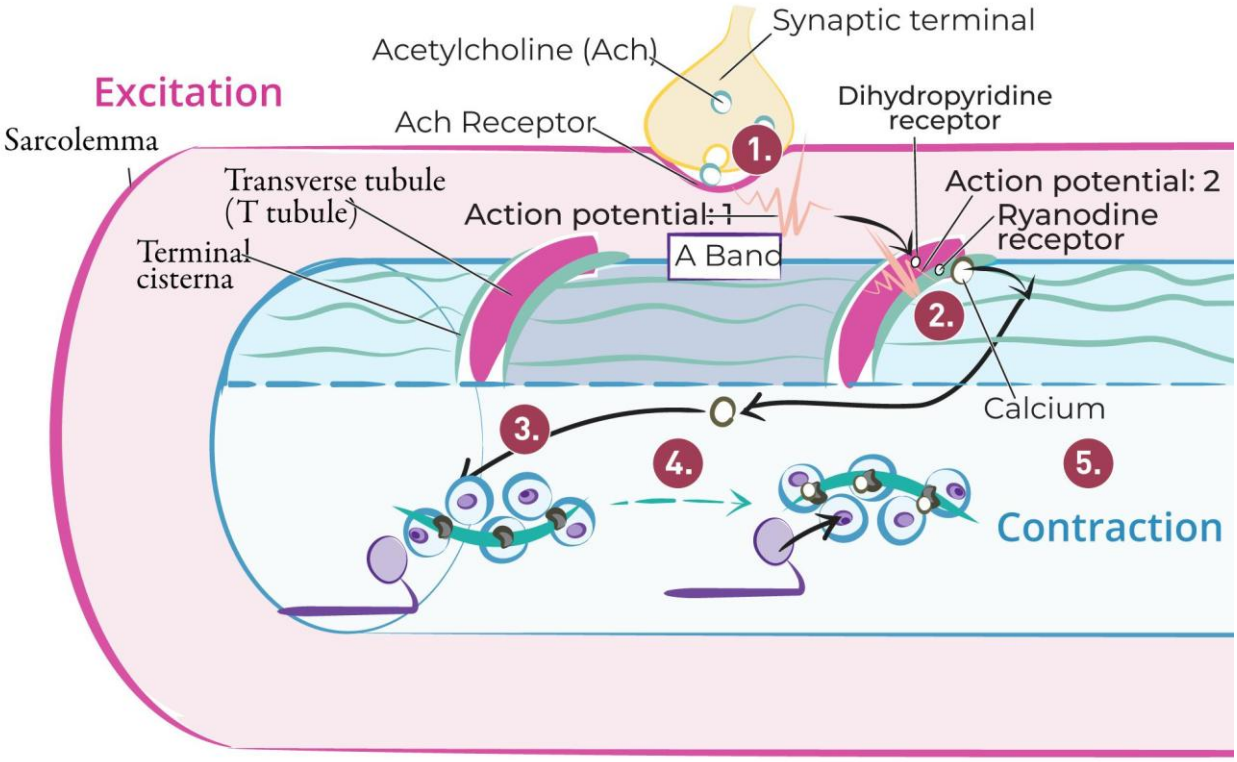
Excitation-Contraction Coupliing Skeletal Muscle



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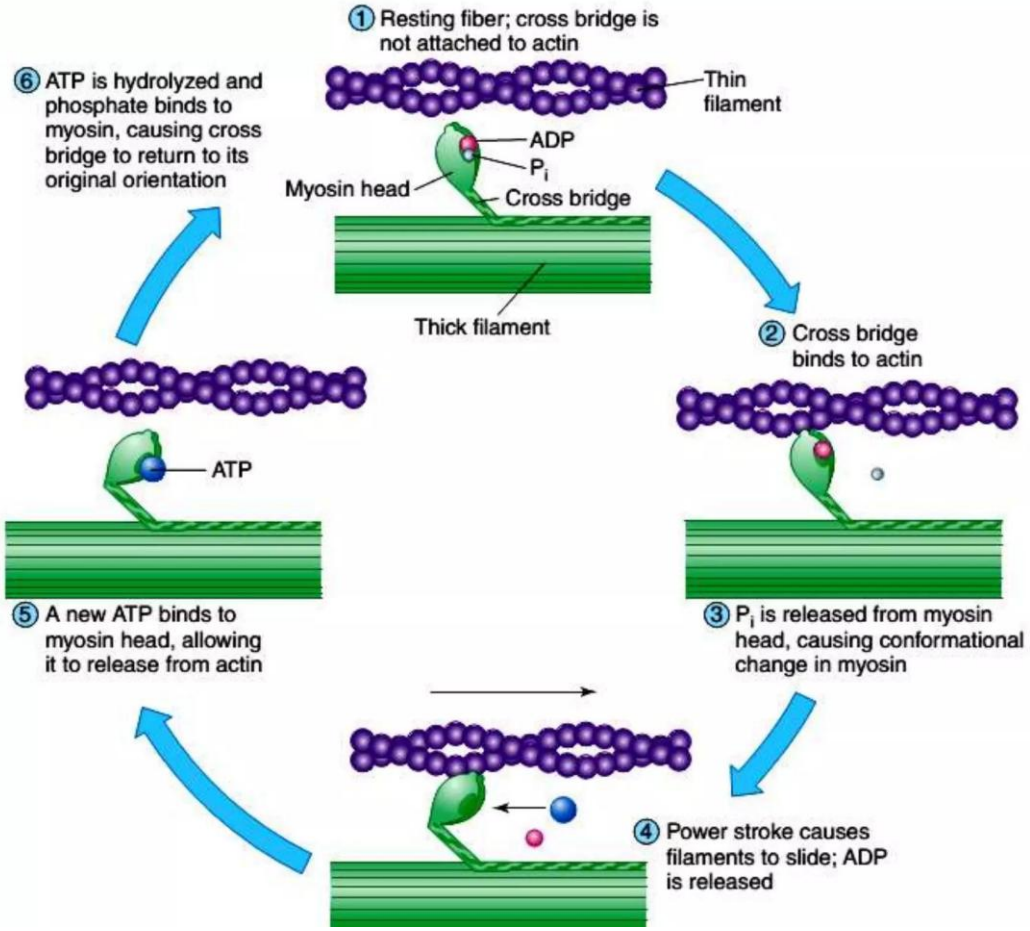

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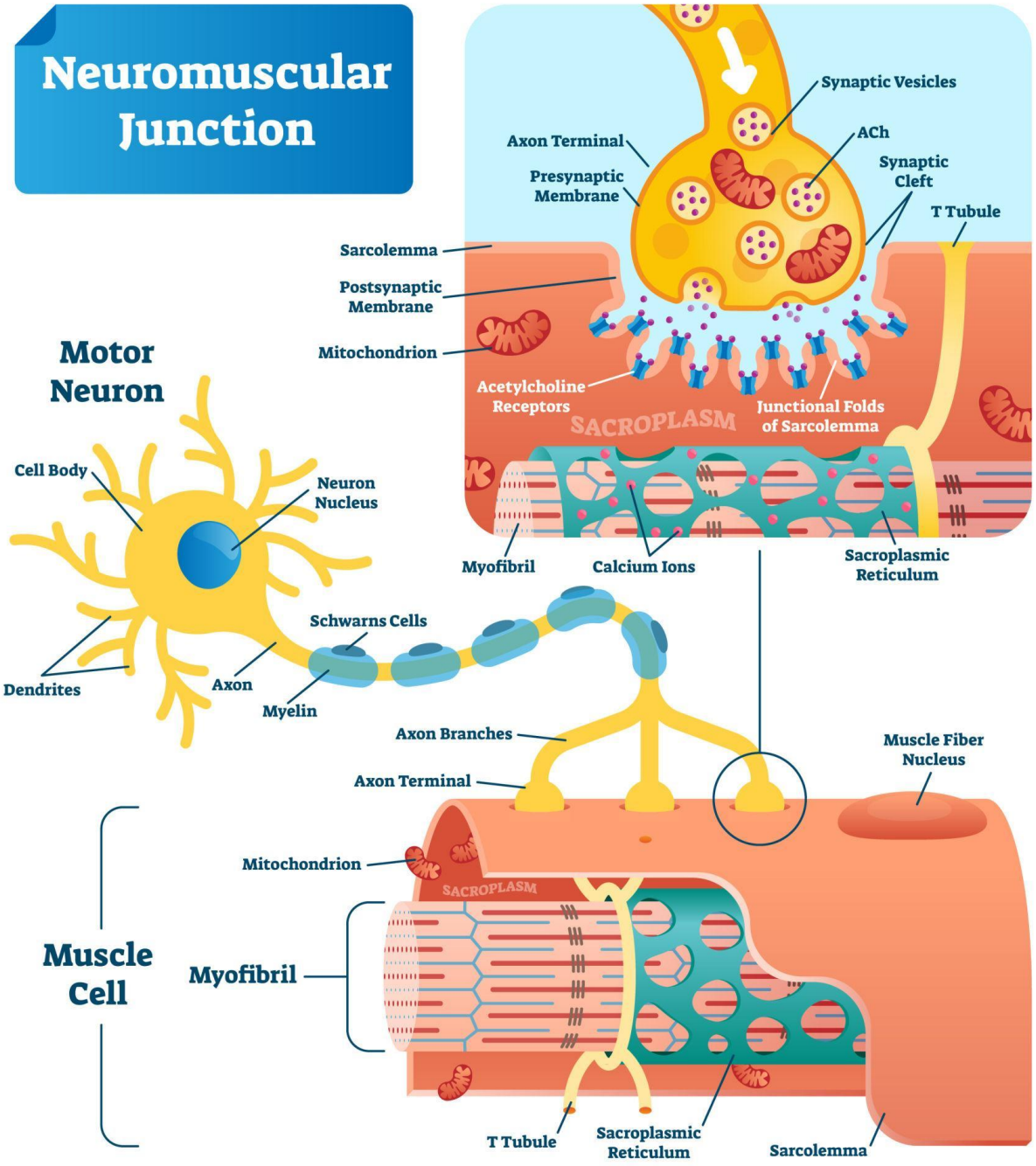

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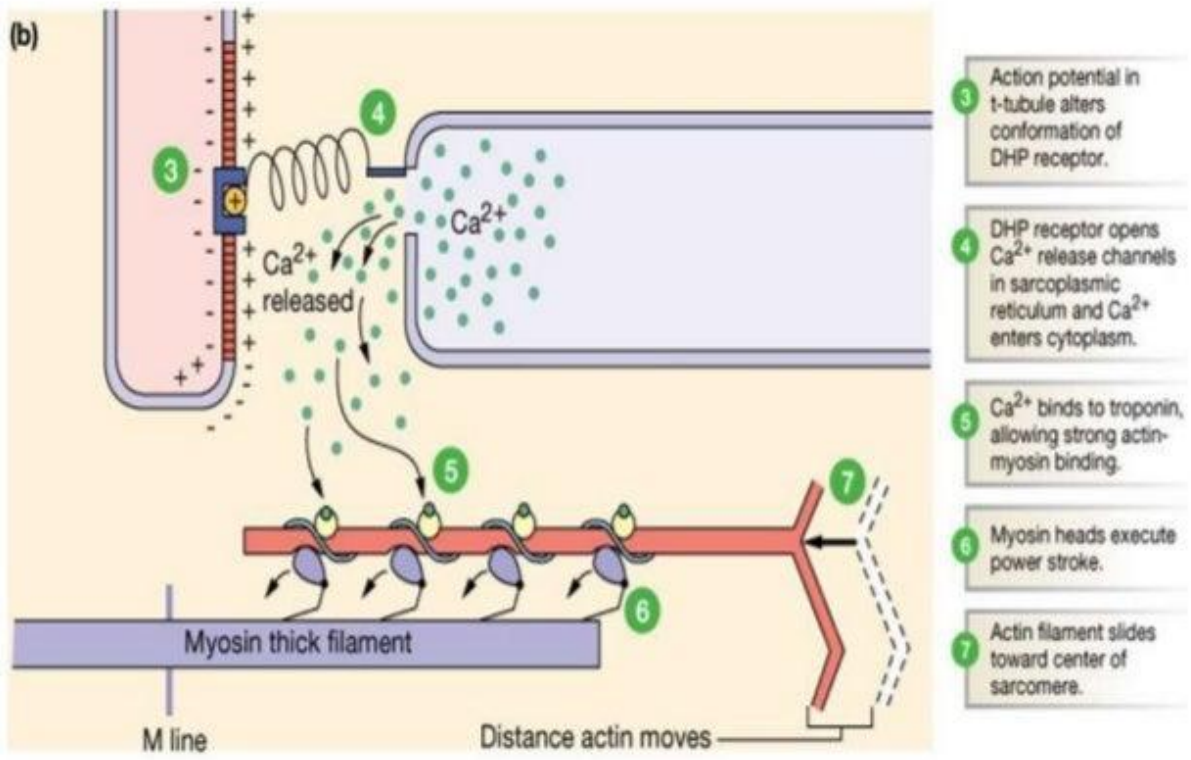
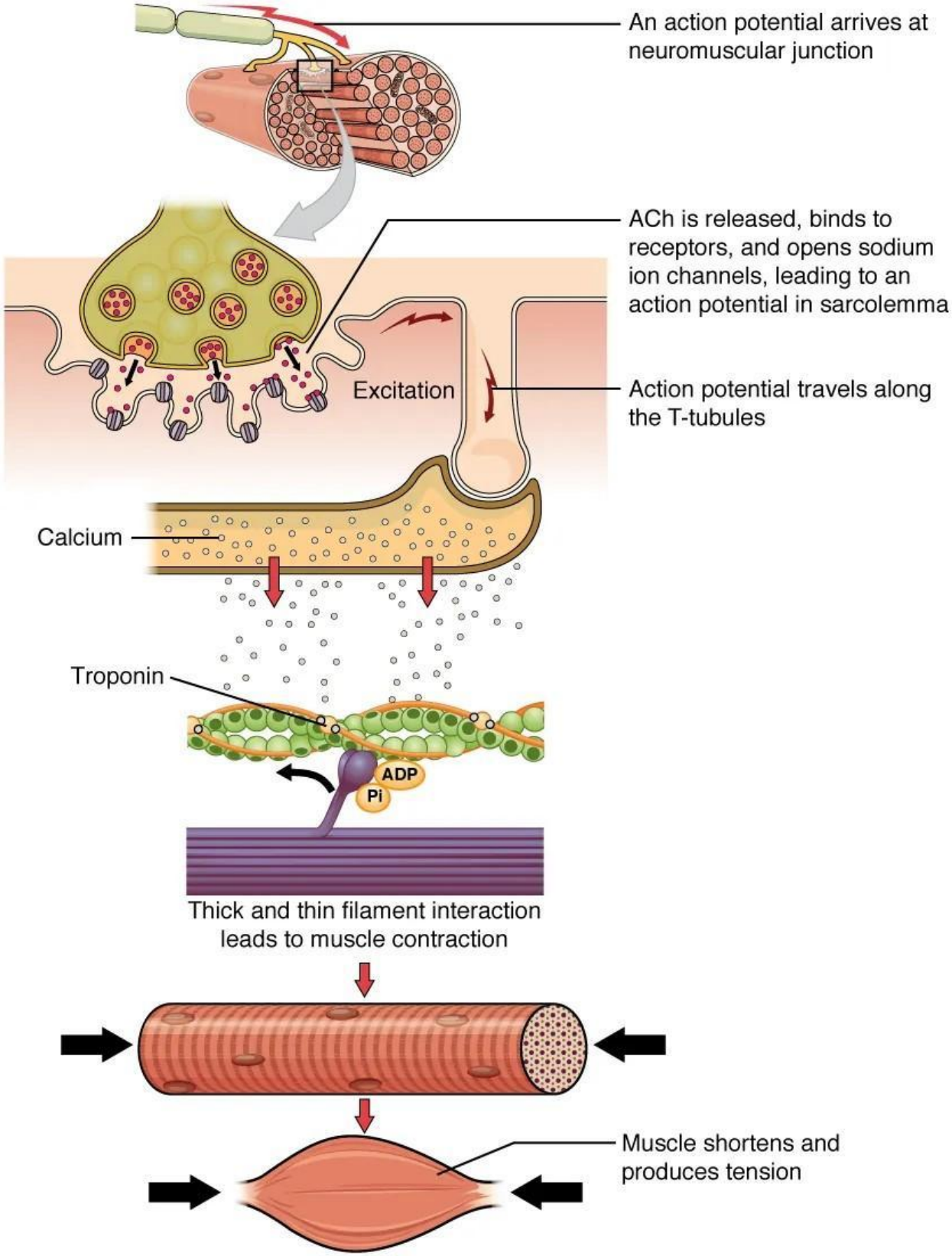
Role of Ca in Skeletal muscle contraction

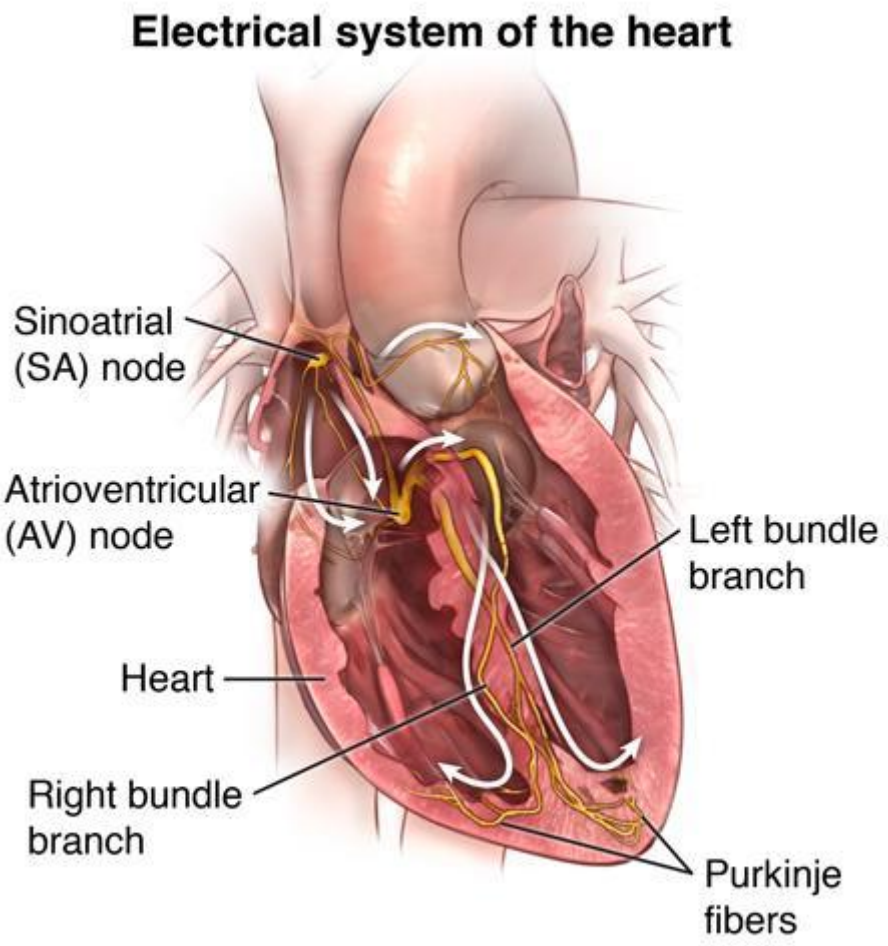


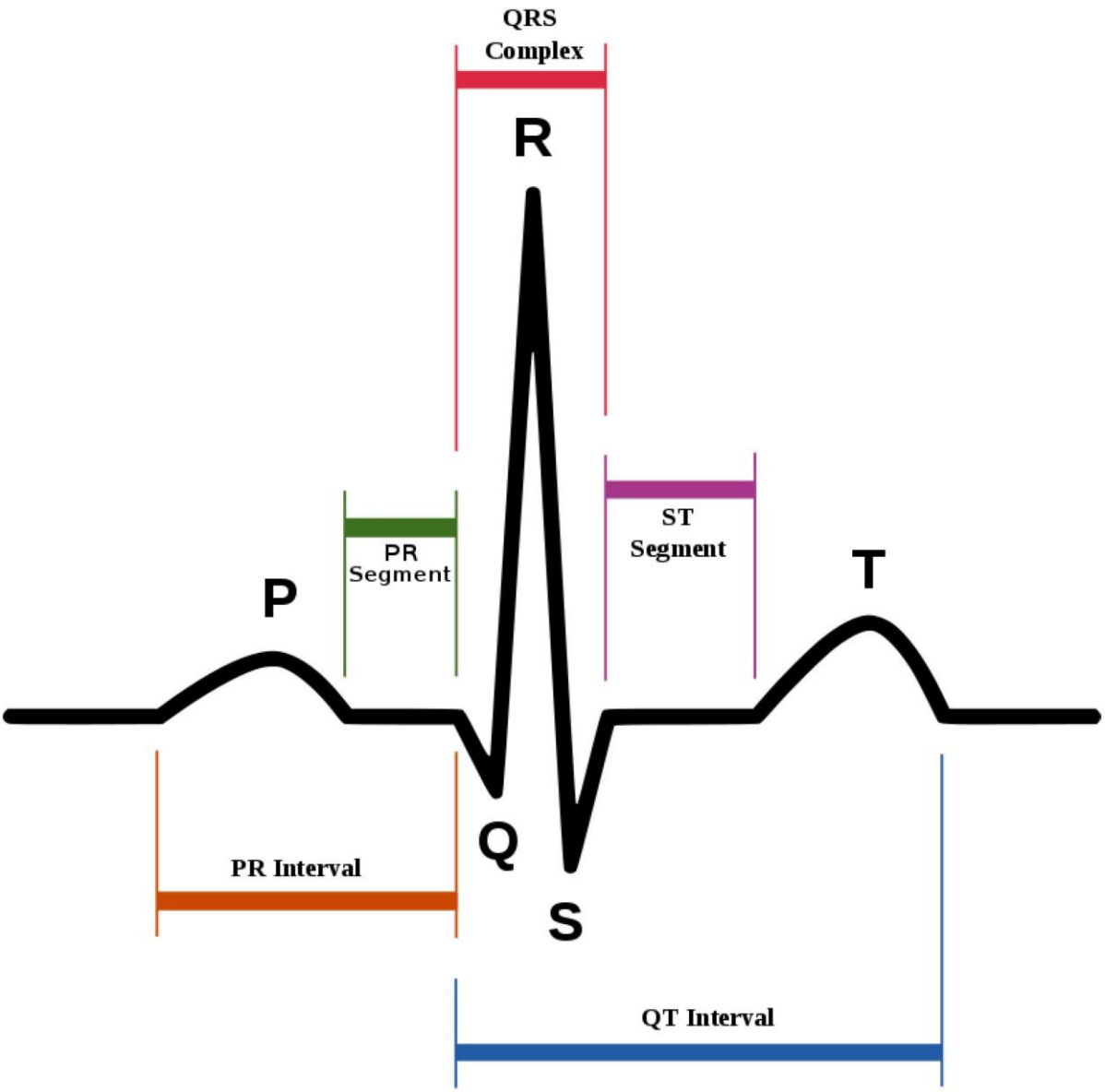


- Nerv impulsi mushakka uzatiladi
- Kalsiy ionlari ajraladi

- Aktin va miozin o‘zaro ta’sirlashadi
- Mushak qisqaradi

5. Yurakning elektr faoliyati




QRS
Complex
R
PR
Segment
ST
Segment
P
T
Q
S
PR Interval
QT Interval

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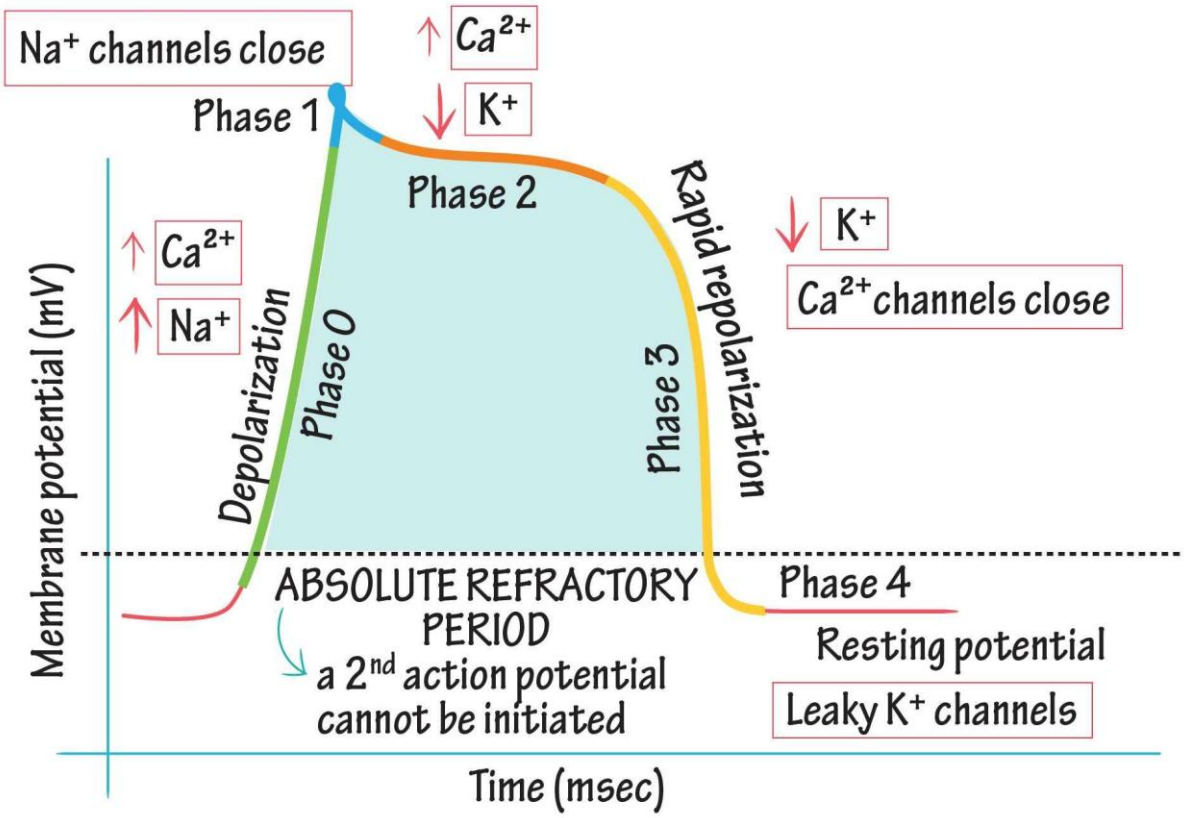
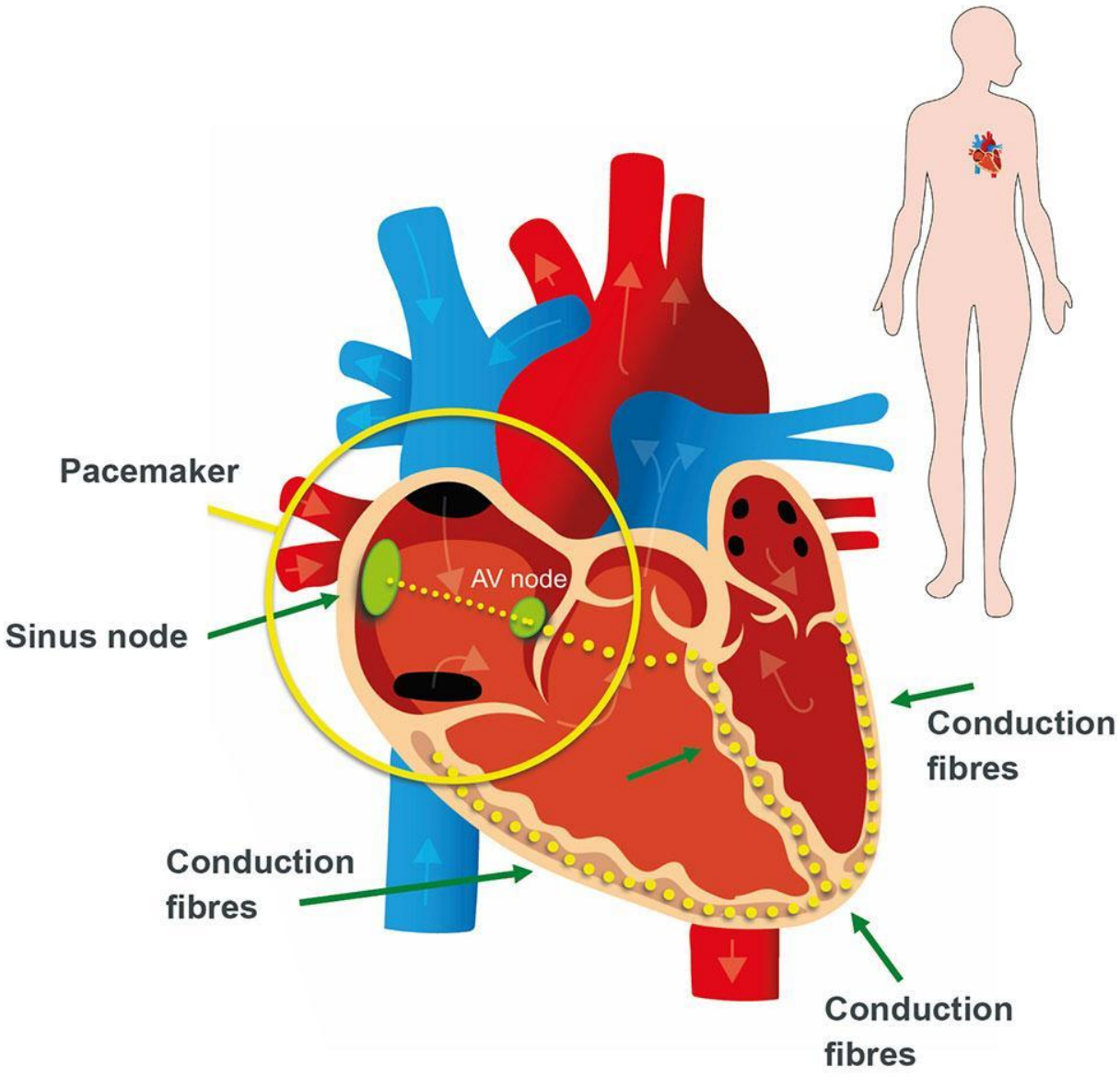
CARDIAC ACTION POTENTIAL



muhadharaty.com


Pacemaker
Sinus node
AV node
Conduction fibres
Conduction fibres
Conduction fibres

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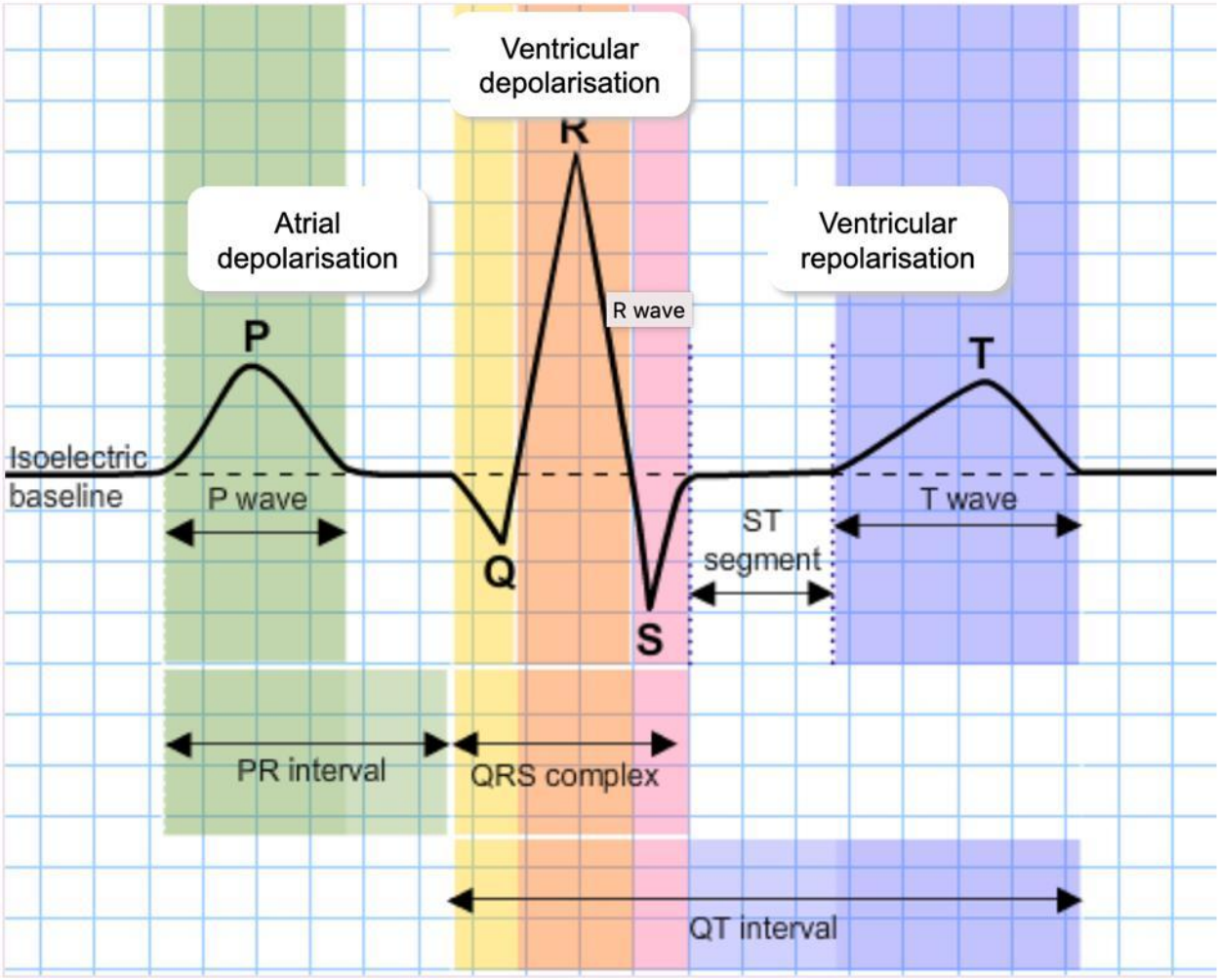

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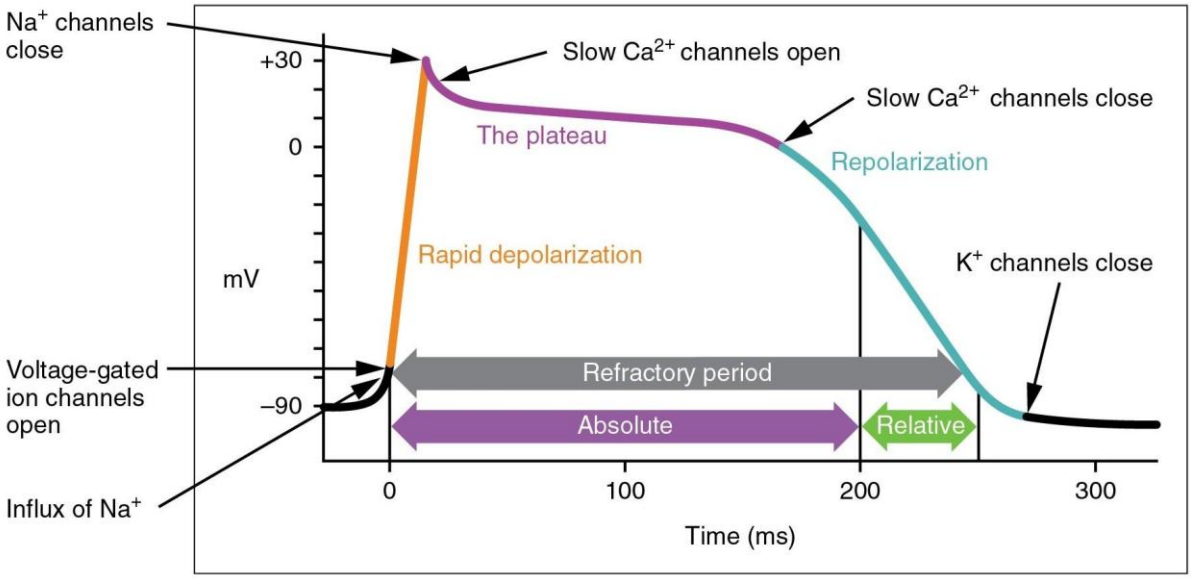
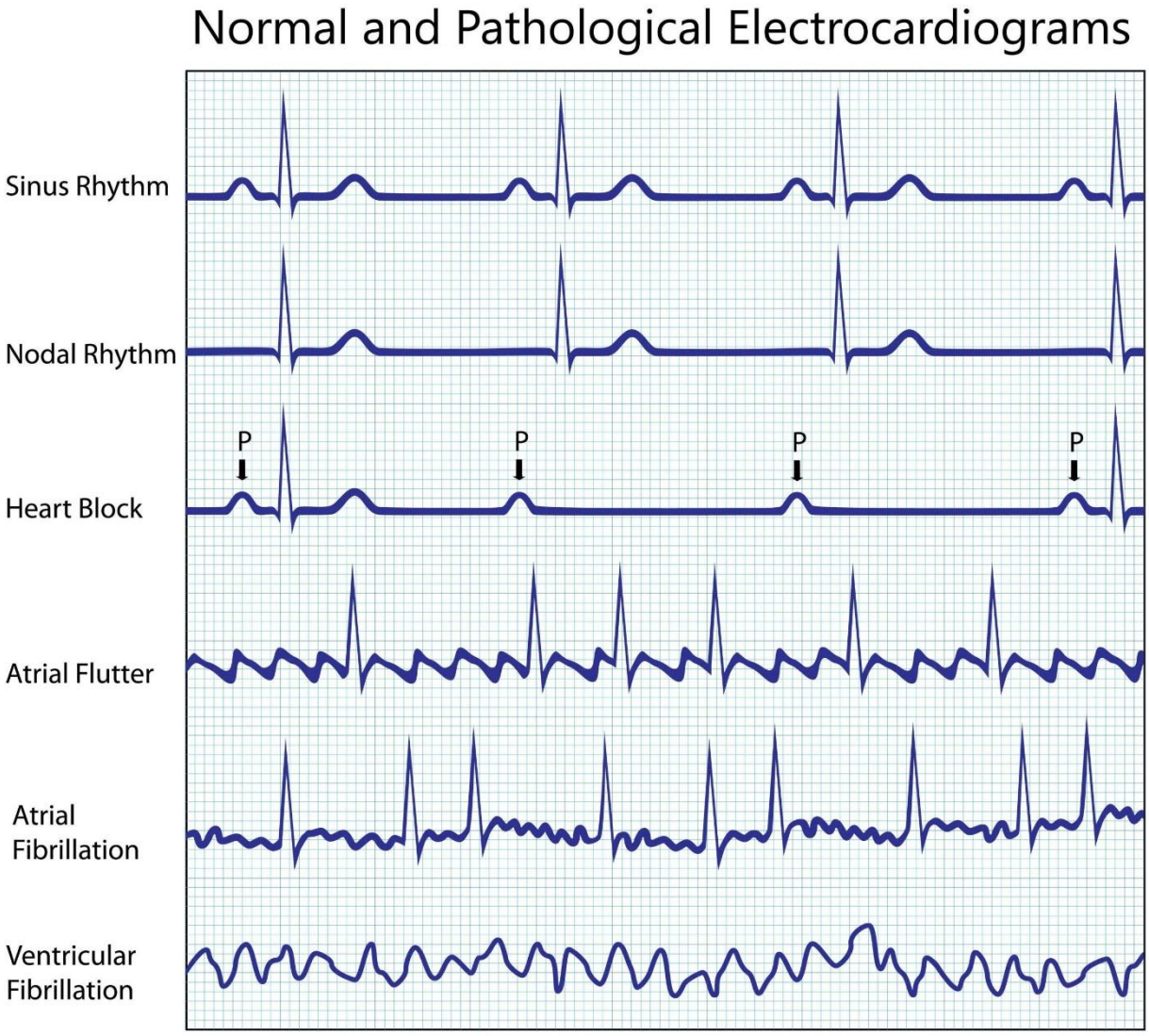


Yurak avtomatik elektr tizimga ega:

- SA tugun — asosiy ritm generatori
- AV tugun — impulsni uzatadi
- His tutami va Purkinye tolalari

Bu tizim yurakning ritmik qisqarishini ta’minlaydi.


Normal and Pathological Electrocardiograms
Sinus Rhythm
Nodal Rhythm
P
P
P
P
Heart Block
Atrial Flutter
Atrial Fibrillation
Ventricular Fibrillation

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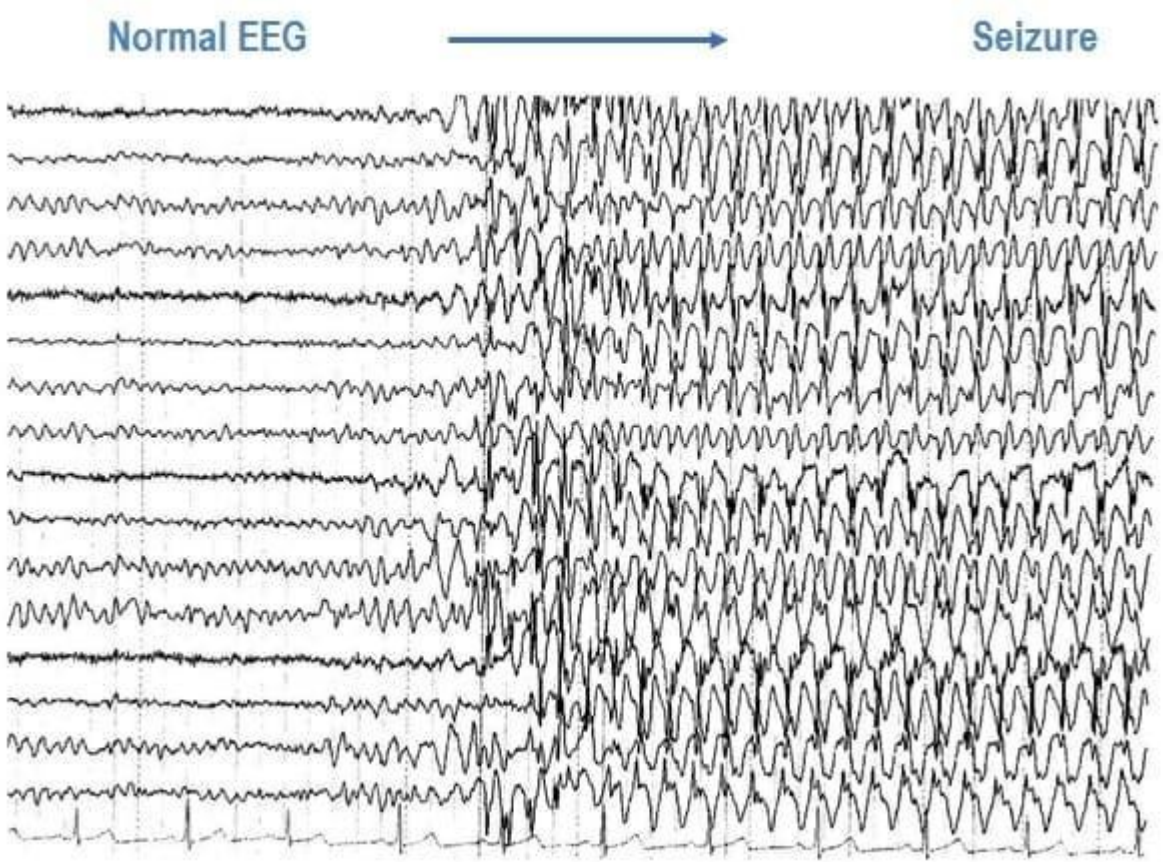
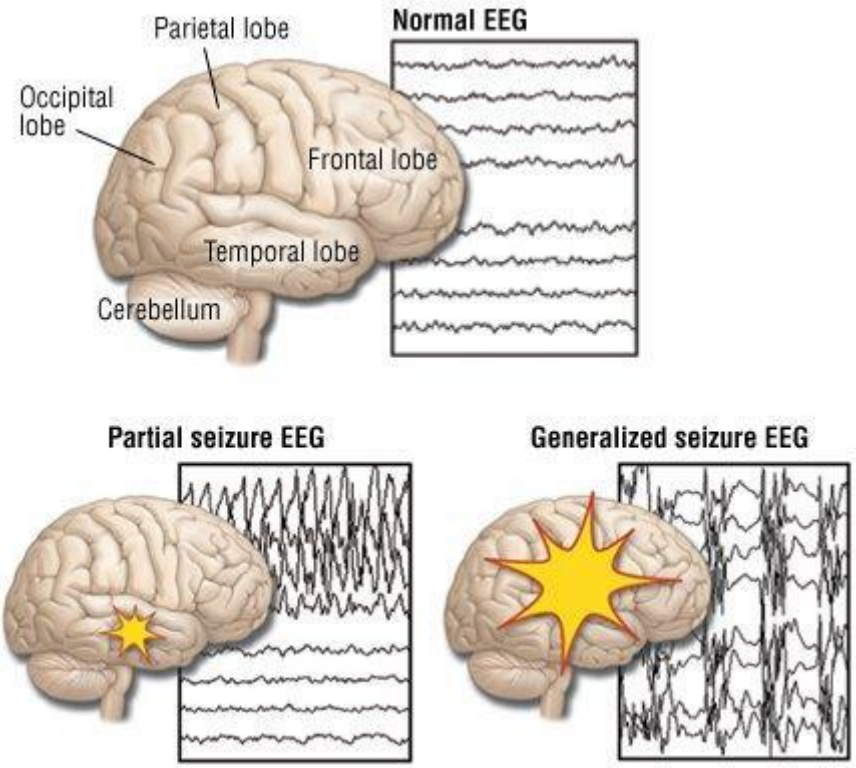


EMG FINDINGS

	LESION / EMG Steps	Normal	NEUROGENIC LESION		MYOGENIC LESION		
			Lower Motor	Upper Motor	Myopathy	Myotonia	Polymyositis
1	Insertional Activity	Normal	Increased	Normal	Normal	Myotonic Discharge	Increased
2	Spontaneous Activity	—	Fibrillation, Positive Wave	—	—	—	Fibrillation, Positive Wave
3	Motor Unit Potential	0.5–1.0 mv, 5–10 msec	Large Unit, Limited Recruitment	Normal	Small Unit, Early Recruitment	Myotonic Discharge	Small Unit, Early Recruitment
4	Interference Pattern	Full	Reduced, Fast Firing Rate	Reduced, Slow Firing Rate	Full, Low Amplitude	Full, Low Amplitude	Full, Low Amplitude



Bioelektrik jarayonlar buzilganda turli kasalliklar yuzaga keladi:

- **Yurak:** aritmiyalar
- **Miya:** epilepsiya
- **Mushak:** miopatiyalar

Diagnostika usullari:

- EKG
- EEG
- EMG

Zamonaviy tibbiyot bioelektrik signallarni chuqur tahlil qilish orqali kasalliklarni erta aniqlash imkonini beradi.

Xulosa

Tirik organizmlarda elektr toki — hayotiy jarayonlarning asosi bo‘lib, nerv tizimi, mushaklar va yurak faoliyatini boshqaradi. Ionlar harakati orqali hosil bo‘ladigan bioelektrik hodisalar organizm ichidagi axborot uzatishning eng muhim mexanizmi hisoblanadi.

Ushbu jarayonlarni chuqur o‘rganish diagnostika va davolash imkoniyatlarini kengaytiradi va zamonaviy tibbiyot rivojida muhim o‘rin tutadi.

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