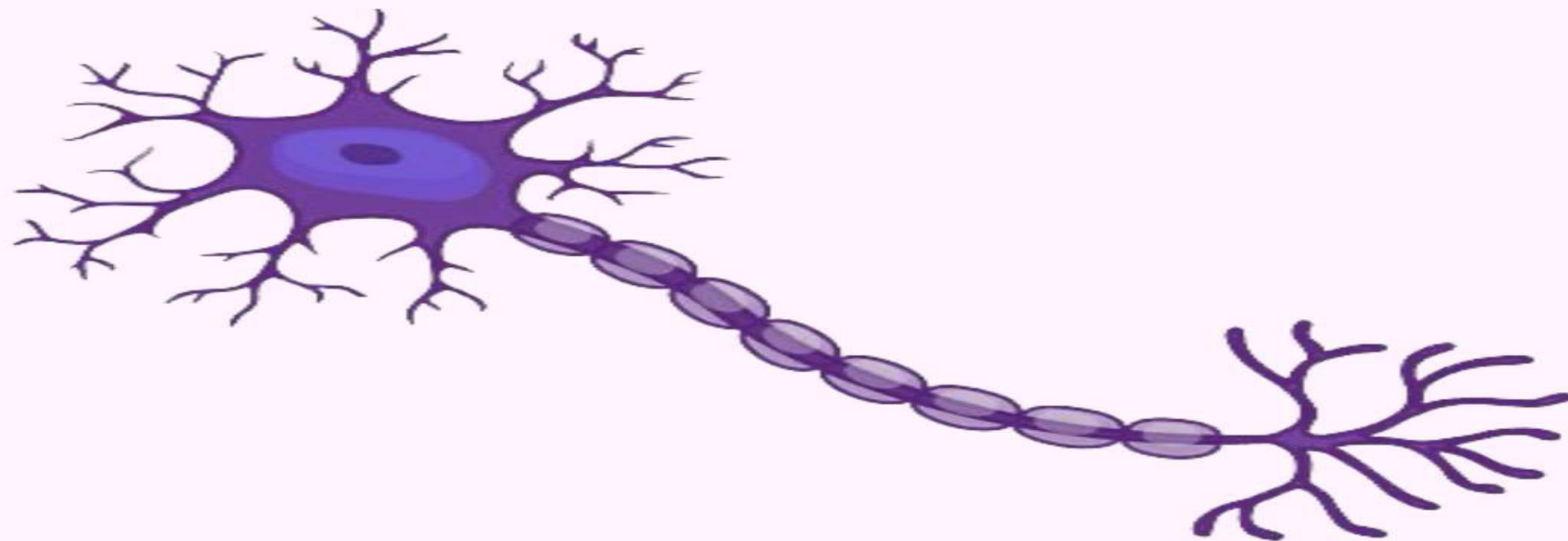




PHYSIOLOGY



LEC NO. : 10

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اشارة عصبية
لانه في عناء فرق في الجهد
Action potential = nerve impulse

اني اعمل تغير او اي تأثير رح يعمل potential change و لازم هاد
المؤثر يكون قوي

-Def: action potential is the potential changes which occur in RMP of the nerve due to stimulation by effective stimulus, these changes propagate (self propagated) along the nerve, then reach the effector organ to produce action (hence the name action potential).

يعني تمر من عصب الى عصب و بالنهاية لل effector organ

رح تضلها تنتقل على الاعصاب لحد ما توصل
لغند العضو المستهدف

الاشارة العصبية = Nerve impulse

و اله اسم ثاني و هو action potential ليش هيك اسمه؟ لانه هون الاشارة اعطتني فكرة معينة و خلتنني اعمل action

و هي عبارة عن القطار بيمشي على قضبان، و القضبان هي انه الاعصاب موجودة بحالة resting membrane potential لكن لما اجي اعمل nerve impulses رح اغير ب RMP و في اله اسم ثاني و هو Polarization و action potential = depolarisation و

During rest, inside the cell , k high concentration,
outside Na high concentration

Ionic basis of action potential

Phases

Action potential is composed of 3 main processes:

A- Depolarization.

لا للاستقطاب، هيجصل ايه؟
رح تتغير charge ف potential رح يتغير، هيبقى جوا + و برا -
اللي حصل انه stimulus عمل فتح لشوية saduim channels ف دخل الصوديوم من برا لجوا ف خلا برا - و جوا +

①

B- Repolarization.

يلي بصير فيها انه برجع polarisation يعني + هتخرج لبرا لكن مو بصورة Na انما K
اللي مسؤول عنه هو potassium outflux & efflux و هو passage of k outside، رجع تاني جوا - و برا +

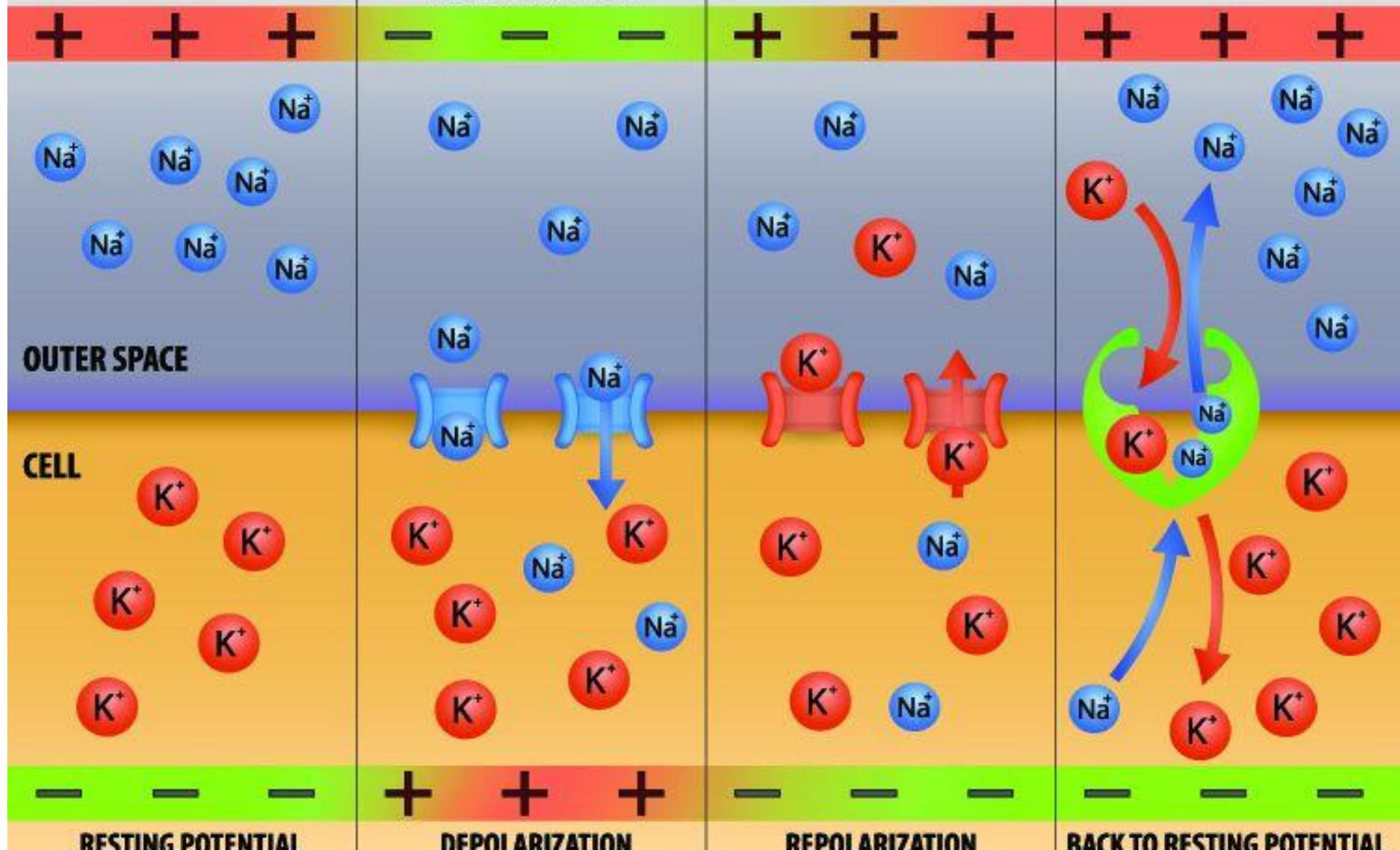
②

C- Redistribution of ions.

بده يرجعها ل normal، هتدخل 2k و تخرج 3Na

③

ACTION POTENTIAL



A) Depolarization:

Def:

-It is loss of normal polarized state of the membrane (□ potential difference between outer and inner surface of the membrane).

- the membrane potential changes from -70 mv to $+35$ mv. تغير في potential

Mechanism:

بيفتح Na channels

-The stimulus increases the permeability of the cell membrane to Na^+ ions, which diffuse inside causing gradual change in the membrane potential from the resting potential (-70 m.v) to isoelectric line (zero) and exceed it to $+35$ mv (overshoot) by 2 steps separated by the firing level which equals -55 mv.:

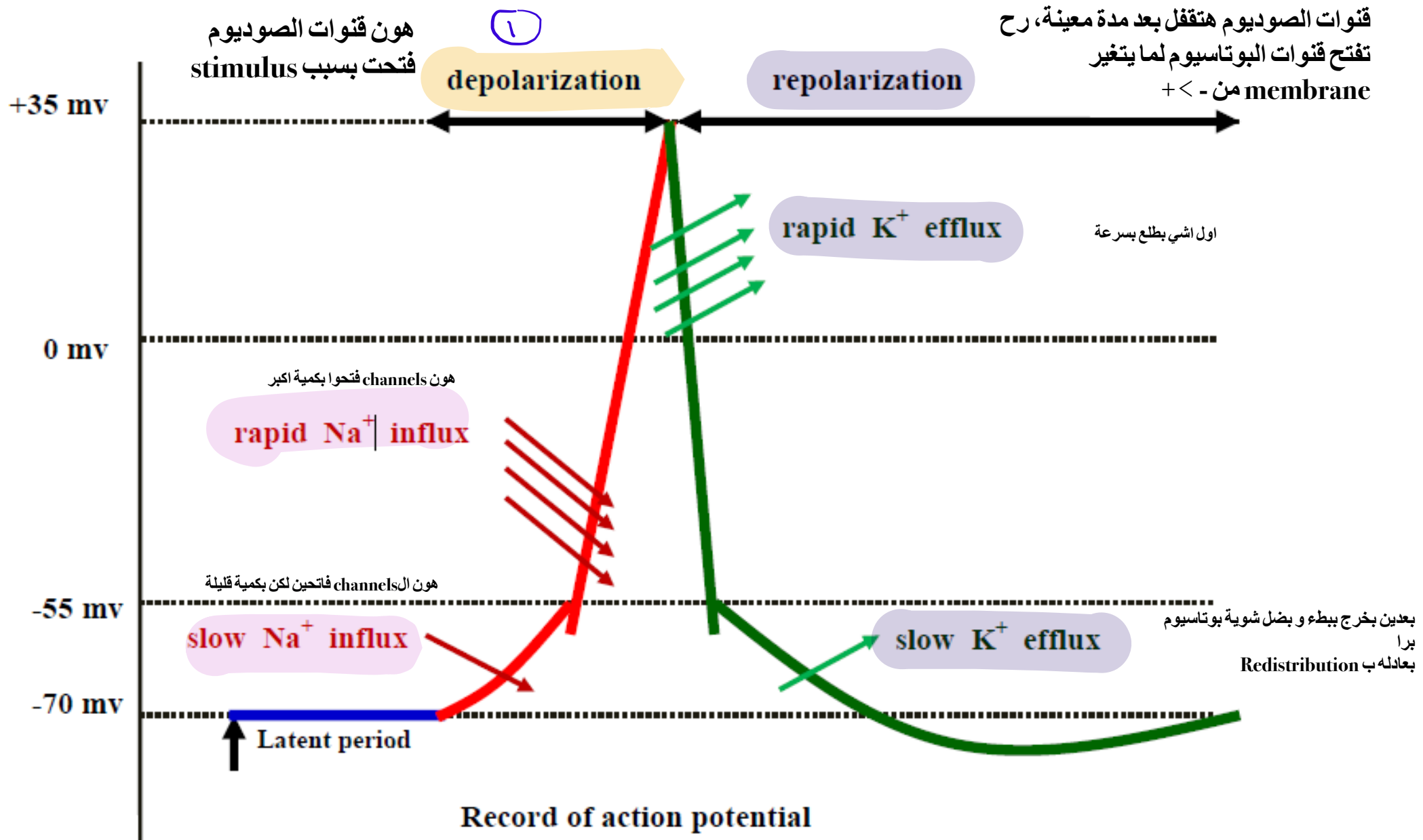
1-Slow depolarization: from -70 mv to -55 mv (firing level) due to opening of some Na^+ channels

بيفتح بعض Na channels

Opens more Na channels when reaches firing level (-55)

2-Rapid depolarization: from -55 mv to $+35$ mv (overshot), due to opening of all Na^+ channels

متذكرين positive feedback يلي شرحها
د سعيد؟ ايوا بالزبط هاي
هي slow & rapid



B) Repolarization: عشان ارجع الخلية لحالتها الطبيعية، بقفل قنوات الصوديوم و بفتح قنوات البوتاسيوم

Def:

- It is restoration of membrane potential i.e return to normal polarity
- The membrane returns from +35 mv to -70 mv.

Mechanism of repolarization:

- 1-stoppage of Na^+ influx.
- 2-begining of K^+ efflux through opening of K^+ channels.

c) Redistribution of ions inside and outside:

- Redistribution of Na^+ and K^+ ions to the normal resting condition is established by sodium potassium pump.

عشان يرجع
للطبيعي

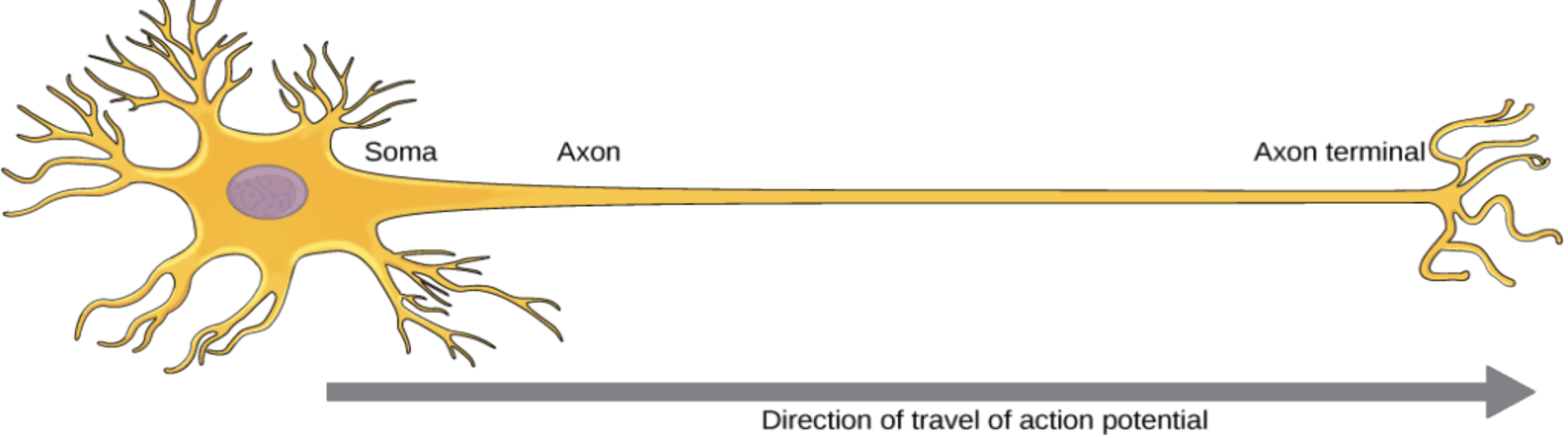
التوصيل

II-Conductivity

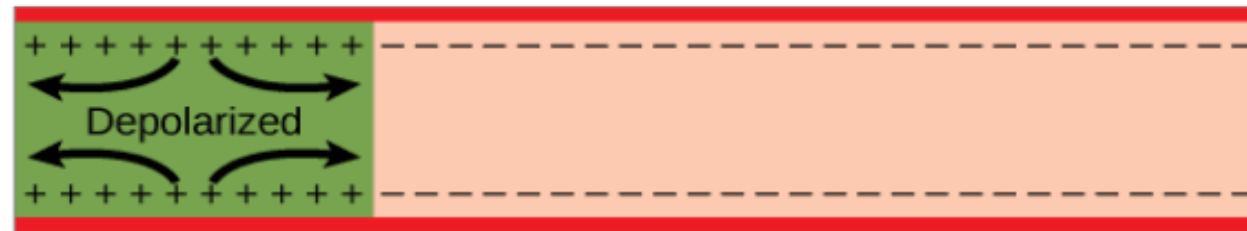
العصب عنده القدرة ليستجيب لأي مؤثر او الإشارة التي جاية من المخ، لو ما كان عننا خاصية conductivity ما رح تنتقل impulse

- **After action potential is initiated, it propagates along the axon** لا بتبلش تنتقل من عصب لعصب
- **The action potential must be propagated in order to transfer information from one place in the nervous system to the other.**
- **Conduction is possible because the action potential generated at one site on the axon, acts as a stimulus for the production of another action potential in the adjacent sites of the axon.**

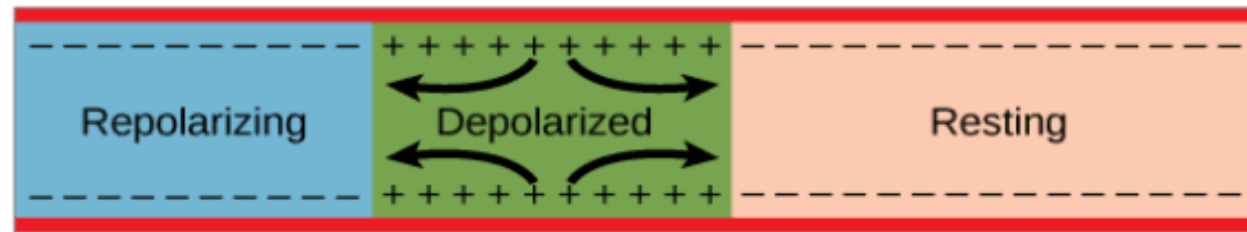
ازاي بيحصل propagation؟
بيحصل لما في جزء حصل في action potential الجزء ده
رح يحفز الجزء يلي بعده عشان يصيرله action potential
وهكذا



a. In response to a signal, the soma end of the axon becomes depolarized.



b. The depolarization spreads down the axon. Meanwhile, the first part of the membrane repolarizes. Because Na^+ channels are inactivated and additional K^+ channels have opened, the membrane cannot depolarize again.



c. The action potential continues to travel down the axon.



2. Types of conductivity

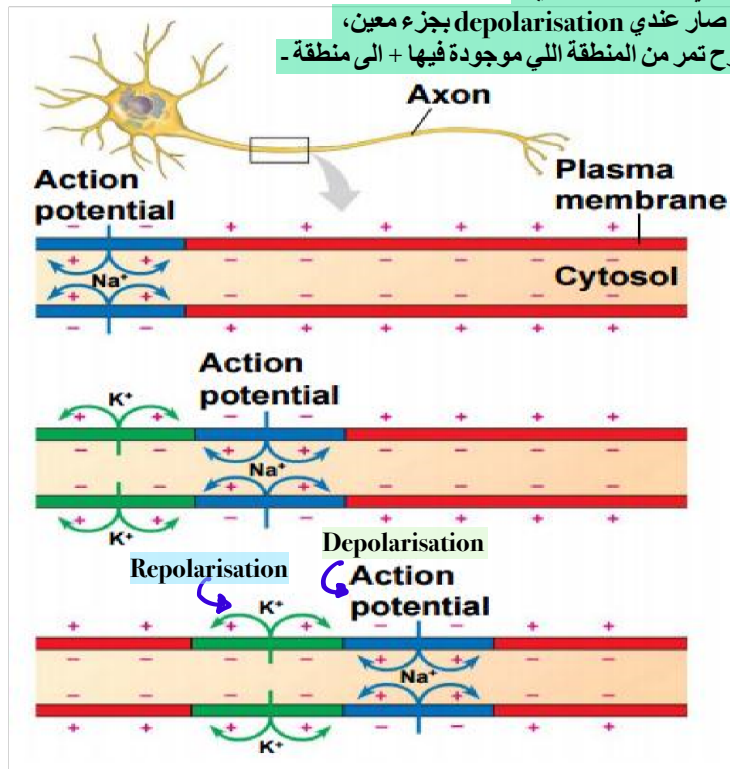
① Continuous conduction

- It is propagation in unmyelinated nerve fibers.

- action potential is conducted from one point to another by local electric circuit.

ببمشي حتته ب حتته، ازاي؟

اناصر عندي depolarisation بجزء معين،
- رح تمر من المنطقة اللي موجودة فيها + الى منطقة -



Velocity of conduction:

Slow (0.5-2.0 meter/sec)

بتكون كثير بطيئة

② Saltatory conduction

- It is propagation in myelinated nerve fibers.

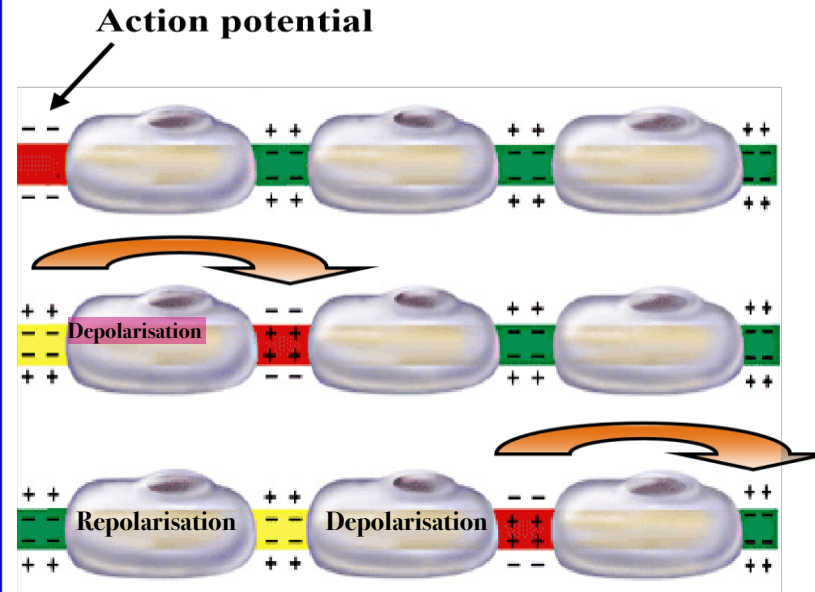
لو بتسرع العملية

- charges jump from one node to another along the nerve causing spread of action potential along the nerve.

بيكون متقطع ببقي في حتته من axon

باينة كل شوية اسمها node

potential along the nerve.



نفس مبدأ continuous بس زي كانه بنط

Velocity of conduction:

Fast (may reach up to 120 met/sec).

TYPES OF SYNAPSES

عشان الإشارة العصبية تنتقل من المخ لمكان معين، مش معقول يكون عصب واحد المسؤول، انما مجموعة اعصاب متشابكة مع بعضها، منطقة التشابك اسمها synapse

The human brain contains at **least 100 billion neurons**, each with the

كل واحد له قدرة على التأثير على غيره

ability to influence many other cells.

Such **communication is made possible by synapses**, the functional

contacts between neurons.

Although there are many kinds of synapses within the brain, they can be

divided into two general classes: ^① electrical synapses and ^② chemical

synapses.

ببتكون فتحة حوالها جسيمات بتكون ورا
بعضها و في عنا قناتهم قناتة تسمح بمرور
الايونات من nerve cell to another
cell

SITES OF ELECTRICAL SYNAPSES

1-Electrical synapses are the neurophysiological product of gap 

junctional pores between neurons that allow bidirectional flow of

Maybe +/-

current between neurons. They are expressed throughout the

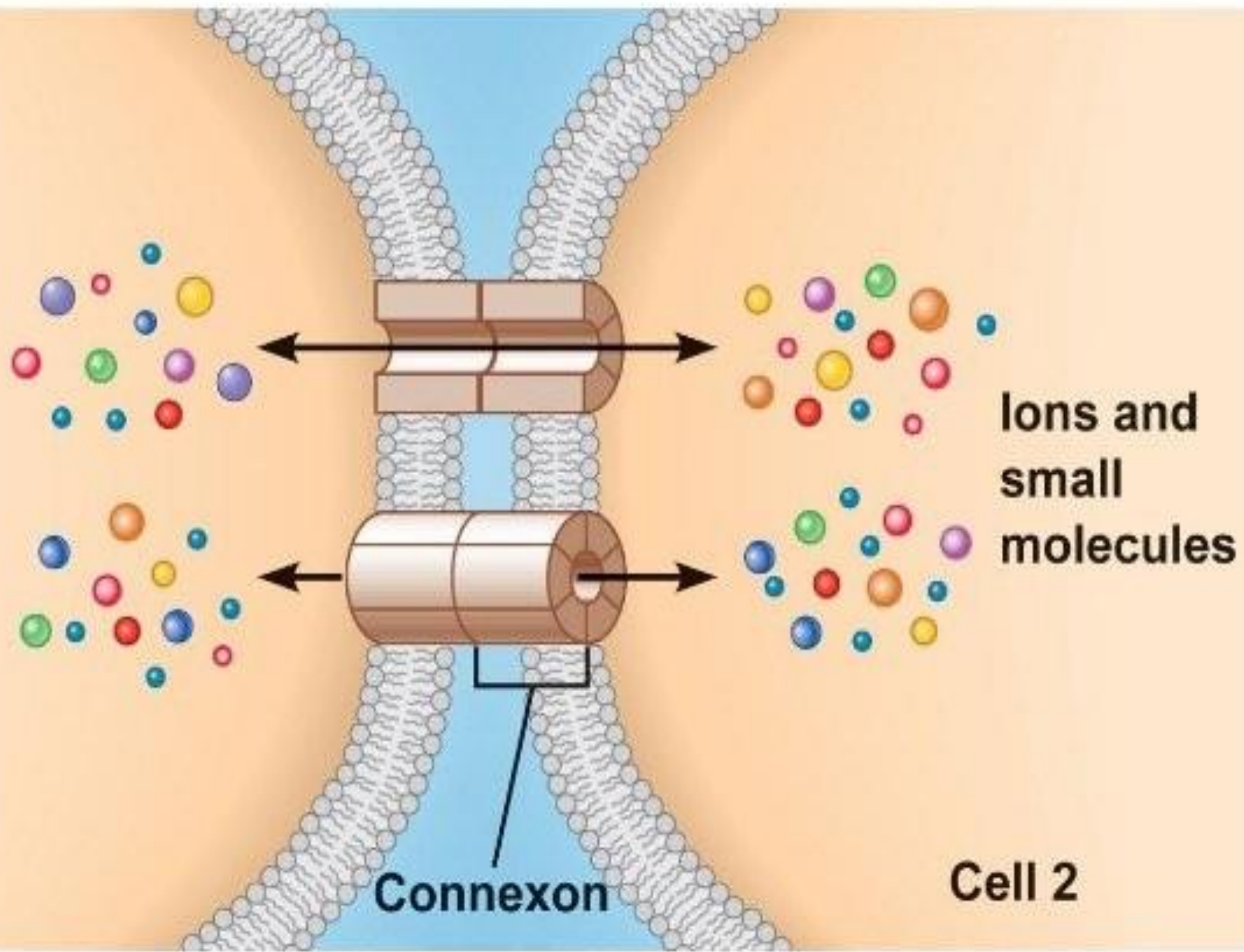
mammalian nervous system, including cortex, hippocampus,

thalamus, retina, cerebellum, and inferior olive.

الاماكن
حفظ

2- In cardiac muscle 

3- in smooth muscles 



Cell 1

Connexon

Cell 2

**Ions and
small
molecules**

TYPES OF SYNAPSES

عملية contact تتم عن طريق ناقل كيميائي موجود في حويصلات و هاي الحويصلات موجودة في نهايات العصب

In contrast, chemical synapses **enable cell-to-cell communication** via the 

secretion of neurotransmitters

ناقل كيميائي

التشابك
قبل Synapse

; **the chemical agents released by the presynaptic neurons** produce secondary

current flow in postsynaptic neurons by **activating**

بعد Synapse (التشابك)

specific receptor molecules

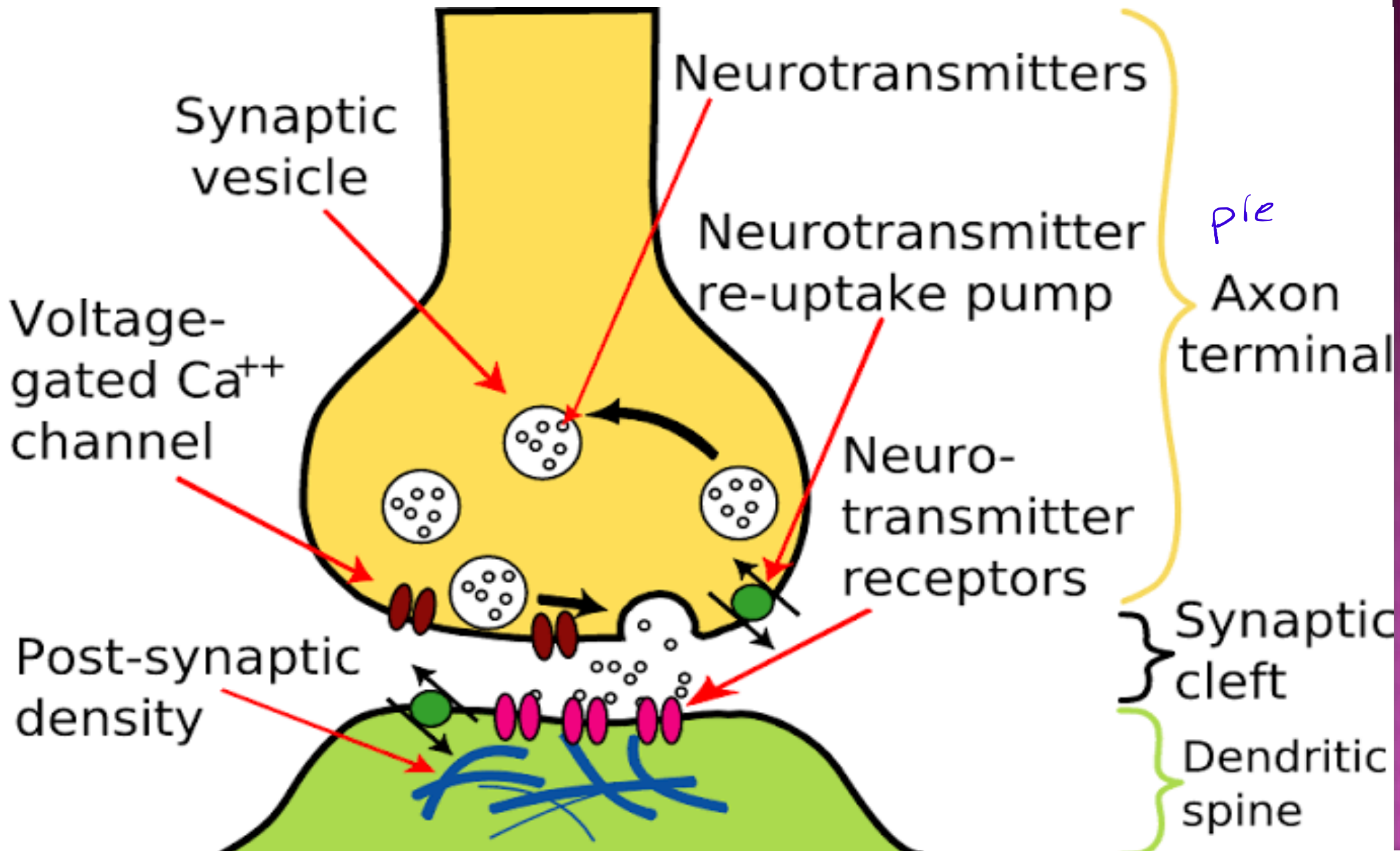
. The secretion of neurotransmitters is triggered by the influx of

Ca^{2+} through voltage-gated channels, **which gives rise to a transient increase**

in Ca^{2+} concentration within the

presynaptic terminal.

الحويصلات تحتوي على ناقل كيميائية، الاشارة العصبية لما تمر تفتح قنوات الكالسيوم و هي voltage gated يعني بتفتح باشارة كهربائية ف بيدخل ca و هو بلعب دور انه يخلي بروتين موجود بالحويصلة يتحد مع بروتين في الجدار و يطلعوا الناقل الكيميائي و يتحد مع المستقبل و يؤدي الى action في العصب الثاني



THE MECHANISM OF CHEMICAL SYNAPTIC TRANSMISSION

-**The rise in Ca^{2+} concentration** causes synaptic vesicles—the presynaptic organelles that store neurotransmitters—to fuse with the presynaptic plasma membrane and release their contents into the space between the pre- and postsynaptic cells.

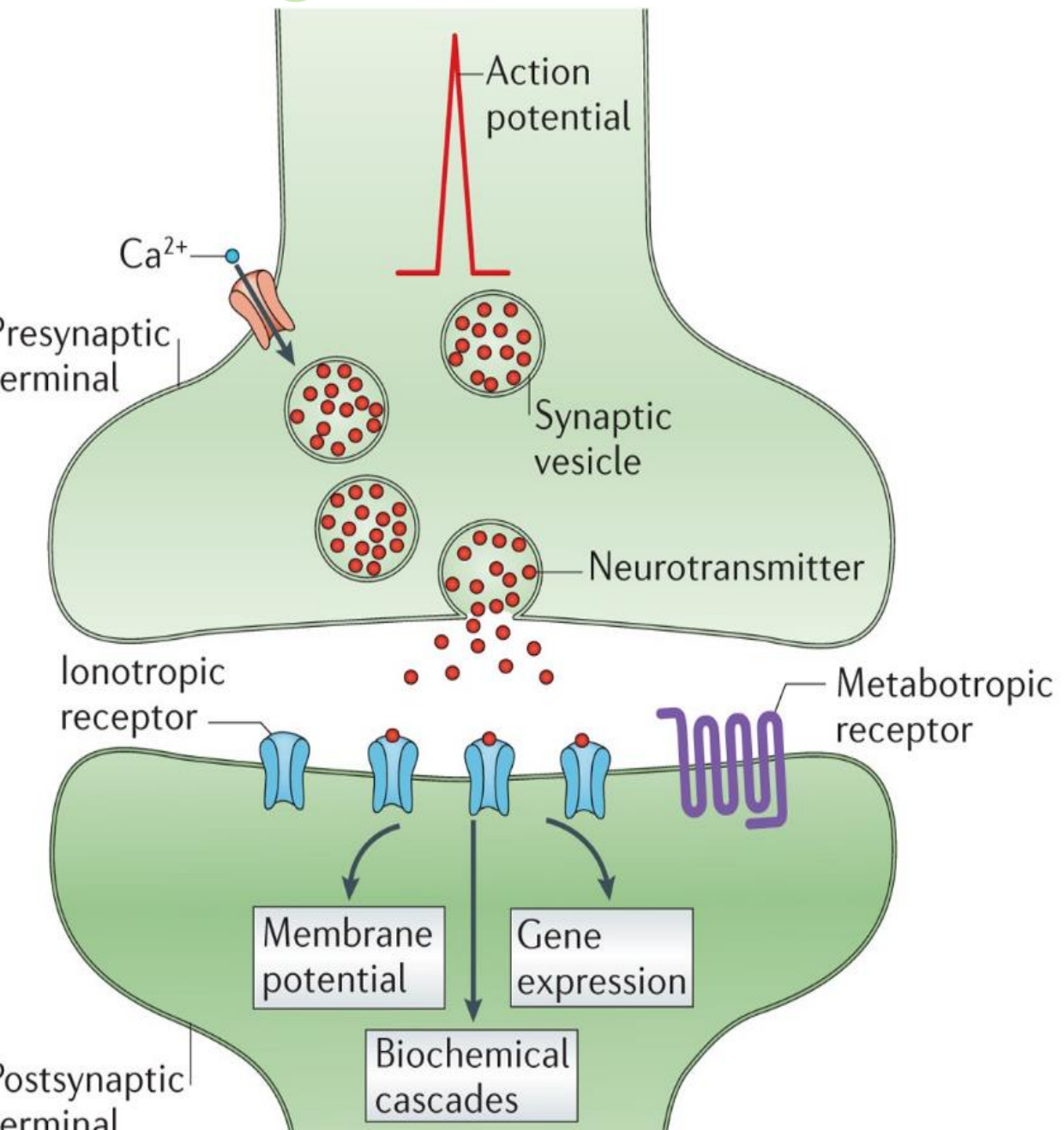
-Although it is not yet understood exactly how Ca^{2+} triggers exocytosis, specific proteins on the surface of the synaptic vesicle and elsewhere in the presynaptic terminal evidently mediate this process.

SITES OF CHEMICAL SYNAPSES

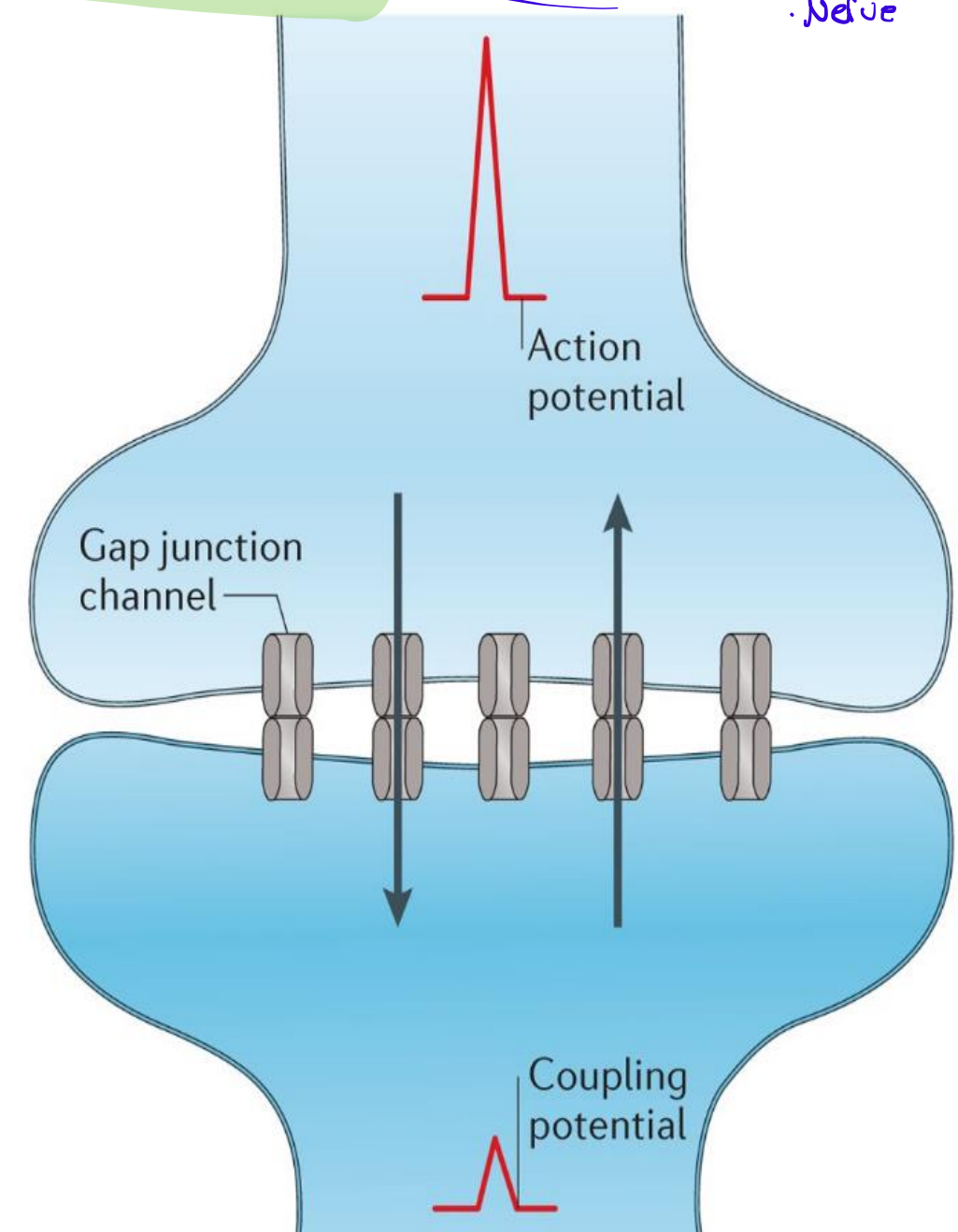
-**Chemical synapses** are biological junctions through which neurons' signals can be sent to each other and to non-neuronal cells such as those in muscles or glands.

Chemical synapses allow neurons to form circuits within the central nervous system. They are crucial to the biological computations that underlie perception and thought. They allow the nervous system to connect to and control other systems of the body.

Chemical synapse *nerve junction*



b Electrical synapse *عن طريق ناقل كيميائي يحدد مع .Nerve*



QUESTIONS

1- which is the main cause of resting membrane potential?

Na diffusion through passive channels (a)

Na diffusion through voltage gated channels (b)

K diffusion through passive channels (c)

Ca diffusion through voltage gated ca channels (d)

Protein diffusion through the cell membrane (e)

2- WHICH IS THE MAIN CAUSE OF DEPOLARIZATION PHASE OF NERVE ACTION POTENTIAL?

Movement of k outside the nerve cell (a)

Na K pump (b)

Chloride influx (c)

Increased permeability of the cell to Na (d)

Movement of K inside the nerve cell (e)

3-DURING THE SLOW PHASE OF DEPOLARIZATION :THE FIRING LEVEL OCCURS AT WHICH OF THESE VALUES?

- 55mv (a)
- +35mv (b)
- 70mv (c)
- 0mv (d)
- 65mv (e)

4- IN RAPID DEPOLARIZATION THE OVERSHOOT OCCURS
AT WHICH OF THESE VALUES?

-90mv (a)

0mv (b)

+35mv (c)

-55mv (d)

+70mv (e)

5- WHICH IS THE MAIN CAUSE OF REPOLARIZATION IN NERVE ACTION POTENTIAL

Na influx (a)

Na k pump (b)

Ca pump (c)

Cl influx (d)

Beginning of k efflux (e)

6- WHICH IS THE CAUSE OF REDISTRIBUTION OF IONS INSIDE AND OUTSIDE THE NERVE CELL AT THE END OF ACTION POTENTIAL?

K efflux (a)

Na influx (b)

Na k pump (c)

Ca pump (d)

Cl influx (e)

7- WHICH IS THE VELOCITY OF CONDUCTION OF NERVE IMPULSE BY SALTATORY CONDUCTION?

- 10 meter per second (a)
- 120 meter per second (b)
- 2 meter per second (c)
- 50 meter per second (d)
- 70 meter per second (e)

8-WHICH IS THE TRIGGER OF RELEASE OF THE CONTENTS OF PRESYNAPTIC VESICLES IN CHEMICAL SYNAPSES?

- Ca influx inside the nerve terminal (a)
- Na influx inside the nerve terminal (b)
- Rise of K level inside nerve terminal (c)
- Chloride exit outside the nerve terminal (d)
- Na efflux outside the nerve terminal (e)

SHORT ESSAY QUESTIONS

- 1-Define RMP ,mention its value and describe its causes ○
- 2-Mention the three basic types of ion channels
- 3-Define action potential and describe its phases ○
- 4-Compare between chemical and electrical synapses as ○
regard the
 - Define sites of expression and mechanism of transmission ○