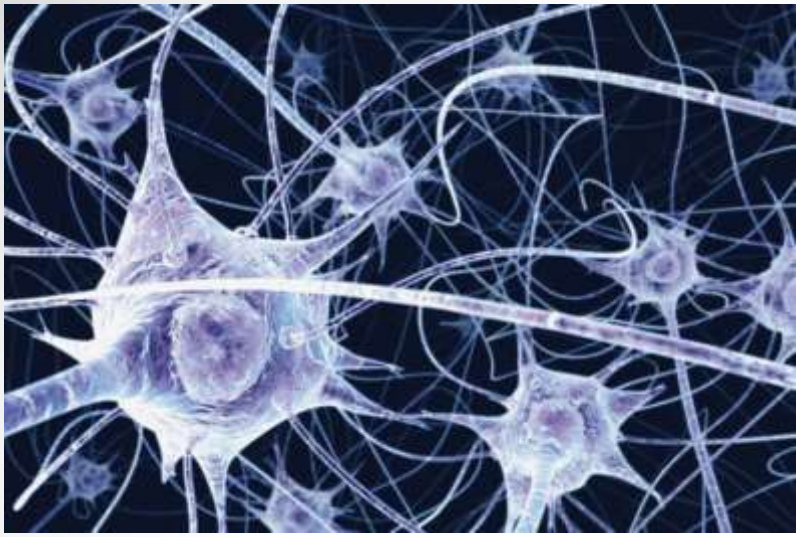
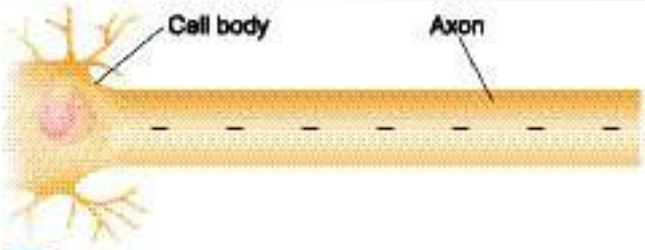


Action Potential

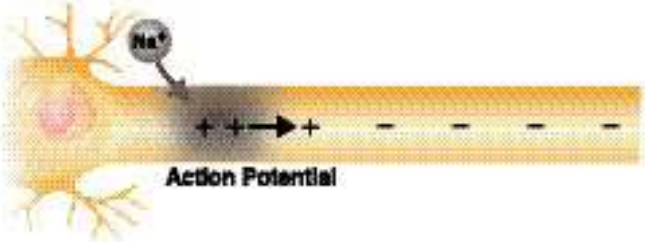
EQ: Explain how an Action Potential is an all or nothing response.

Nerve Impulses

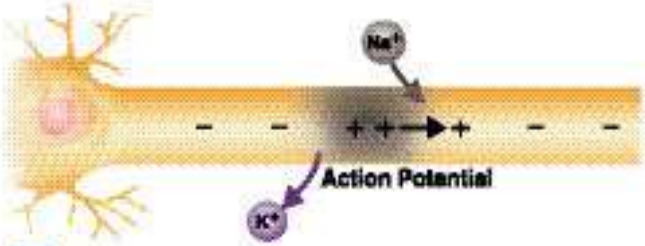
How To Produce An
Action Potential
or…how to think!



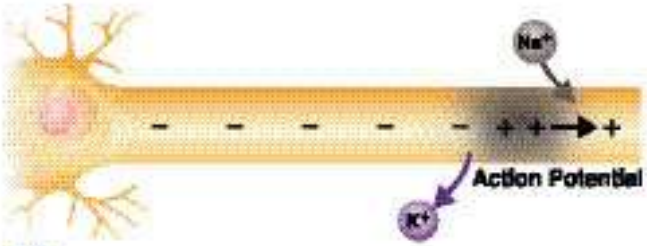
A At rest



B At the leading edge of the impulse, the sodium gates open. The membrane becomes more permeable to Na^+ ions and an action potential occurs.

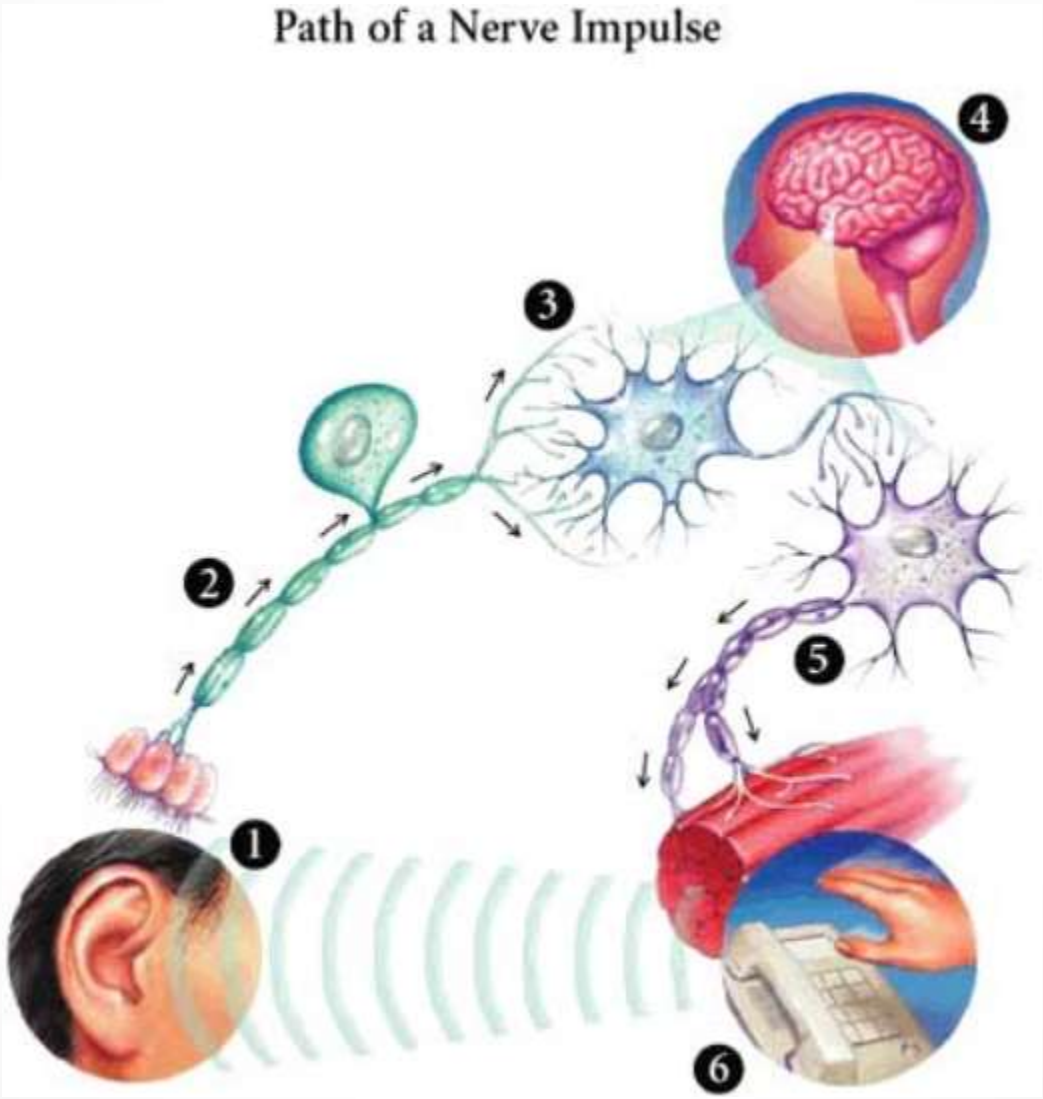


C As the action potential passes, potassium gates open allowing K^+ ions to flow out.

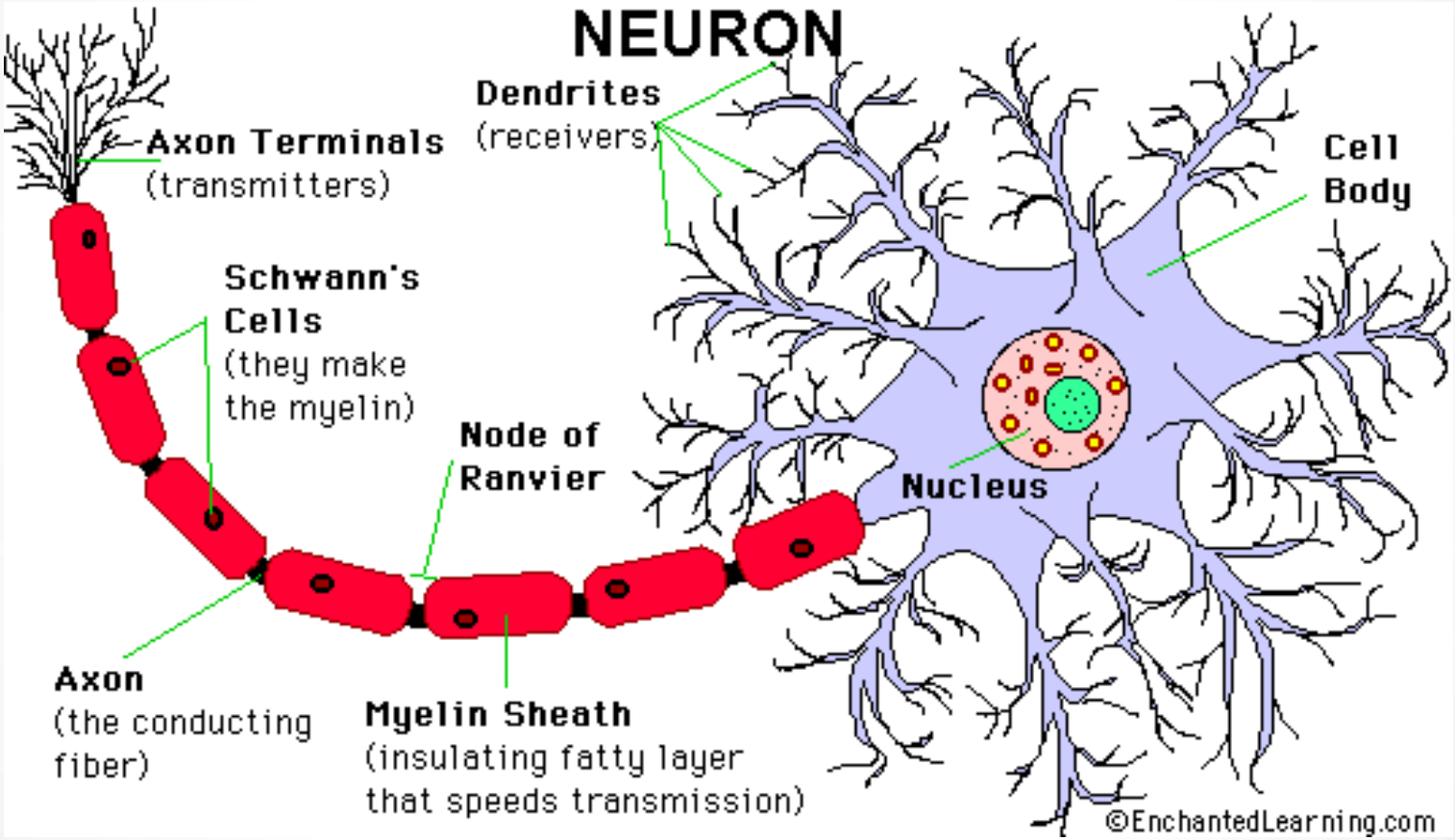


D The action potential continues to move along the axon in the direction of the nerve impulse.

Path of a Nerve Impulse

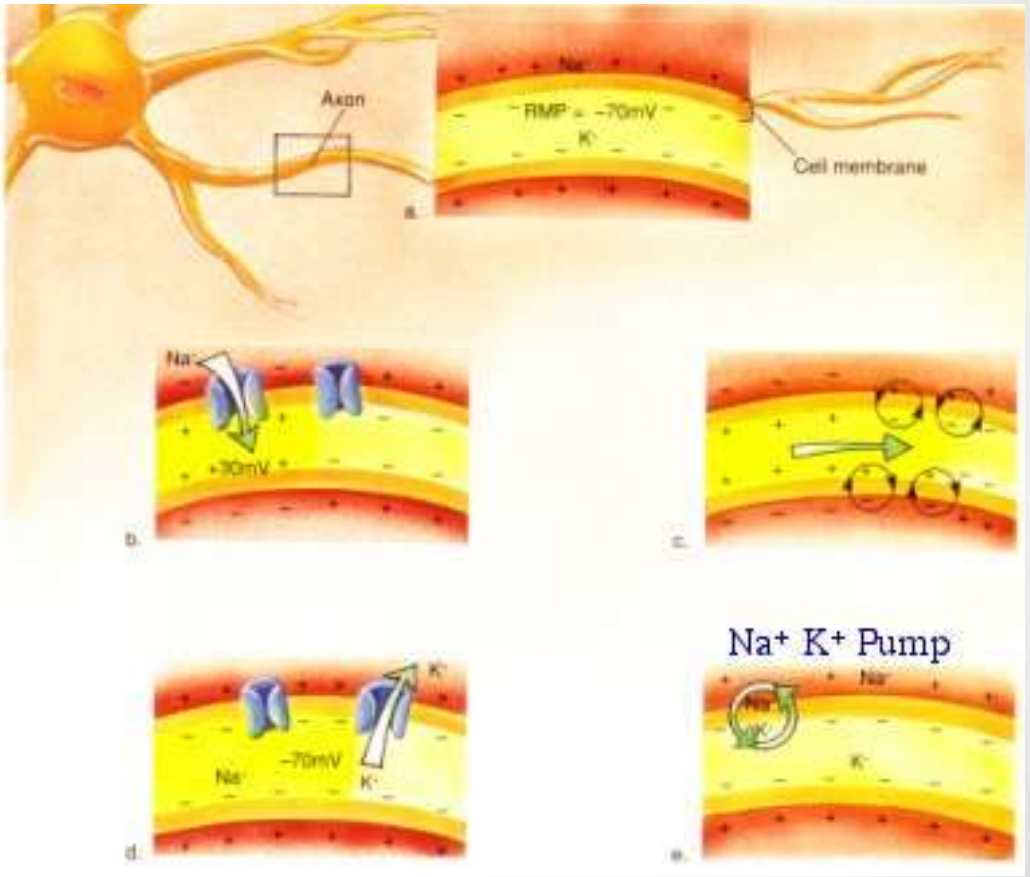


Quick Neuron Review

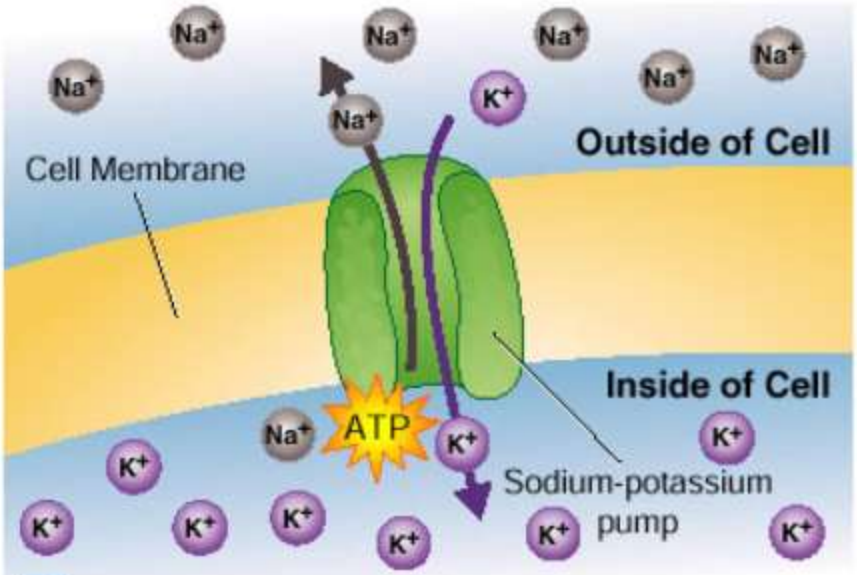


Resting Membrane Potential

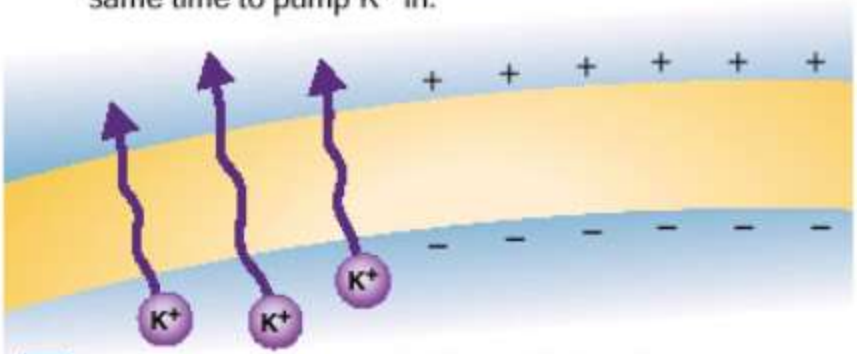
- All cells in the body maintain a voltage difference across the cell membrane called a resting membrane potential.
- The inside of the cell is more negatively charged in comparison to the outside of the cell – this is shown by a negative sign in front of voltage, (ex., -70 mV)
- The big players here are sodium and potassium ions



How this Resting Potential is Maintained



A A protein pump in the neuron cell membrane uses the energy of ATP to pump Na^+ out of the cell, and at the same time to pump K^+ in.

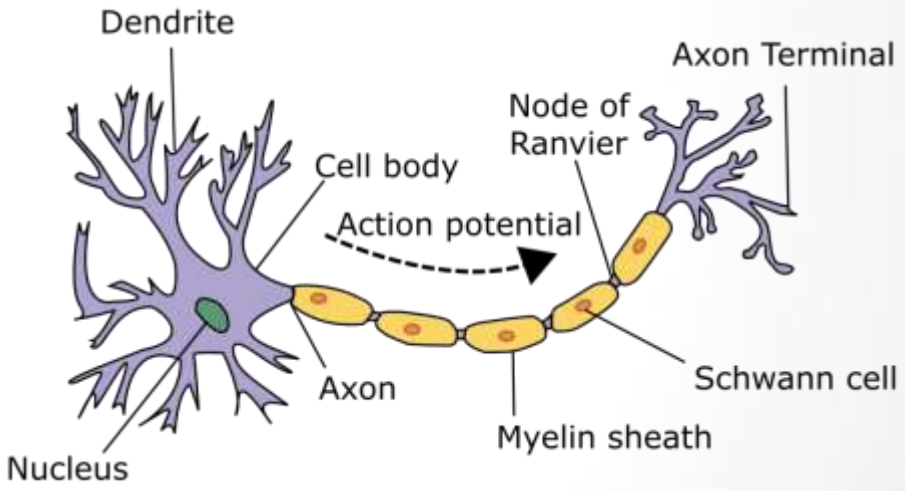


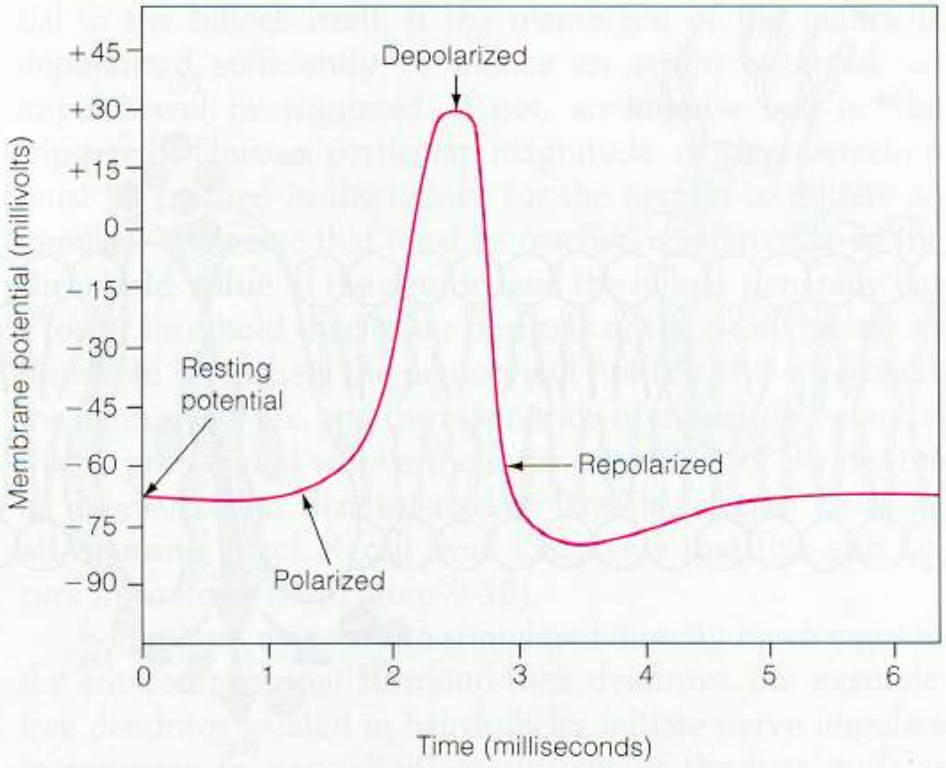
B The cell membrane is leakier to K^+ than it is to Na^+. Because more positive charges leak out of the cell than leak in, the inside of the cell becomes negatively charged with respect to the outside.

- As the figure shows, a Na+ / K+ pump in the cell membrane pumps sodium out of the cell and potassium into it.
- However, more potassium ions leak out of the cell.
- The inside of the membrane builds up a net negative charge relative to the outside.

An Action Potential

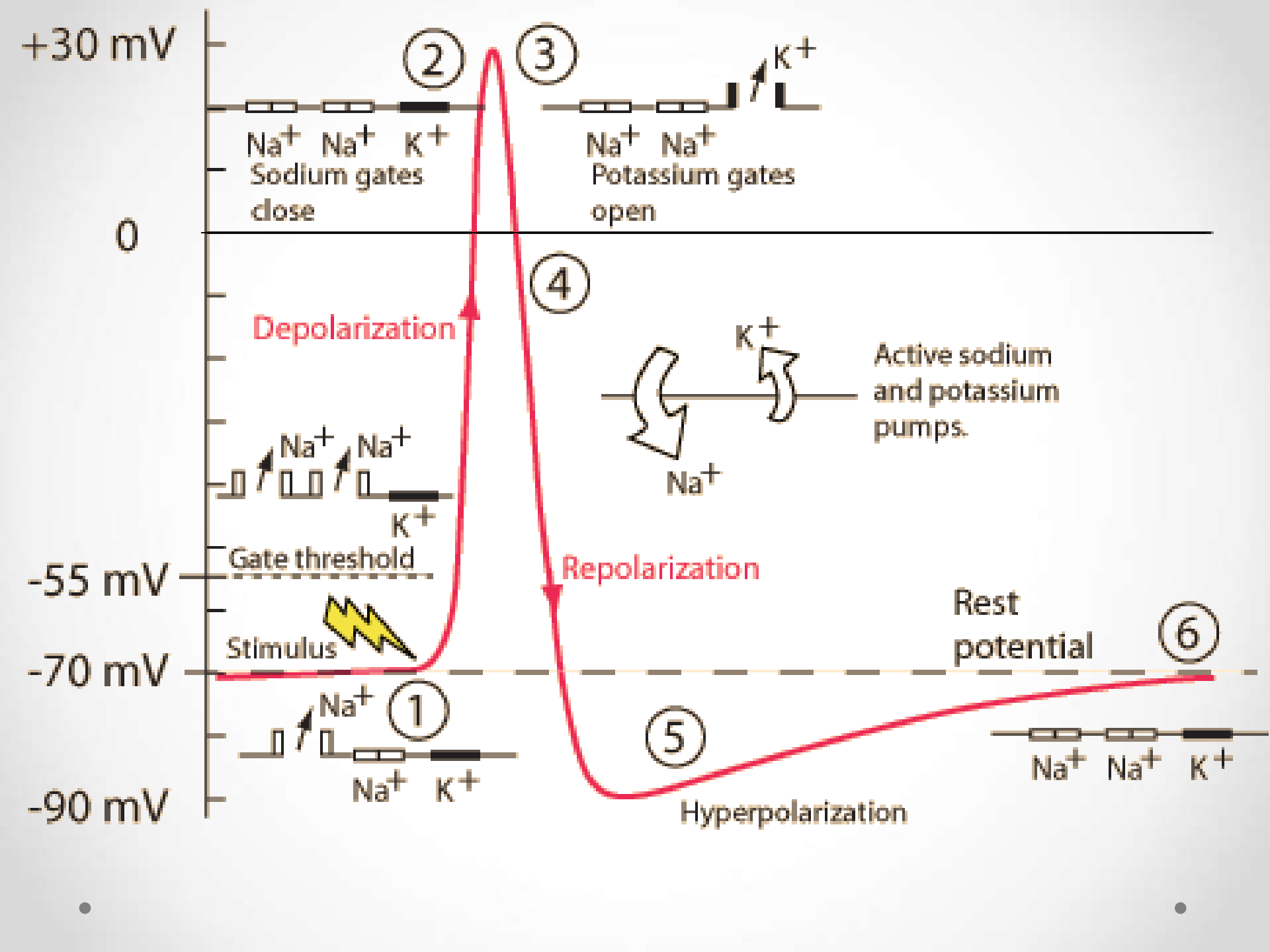
- Depolarization is the beginning of "thought" or the start of an action potential.
- An action potential sweeps down (nerve impulse)an axon to the junction of another neuron or muscle

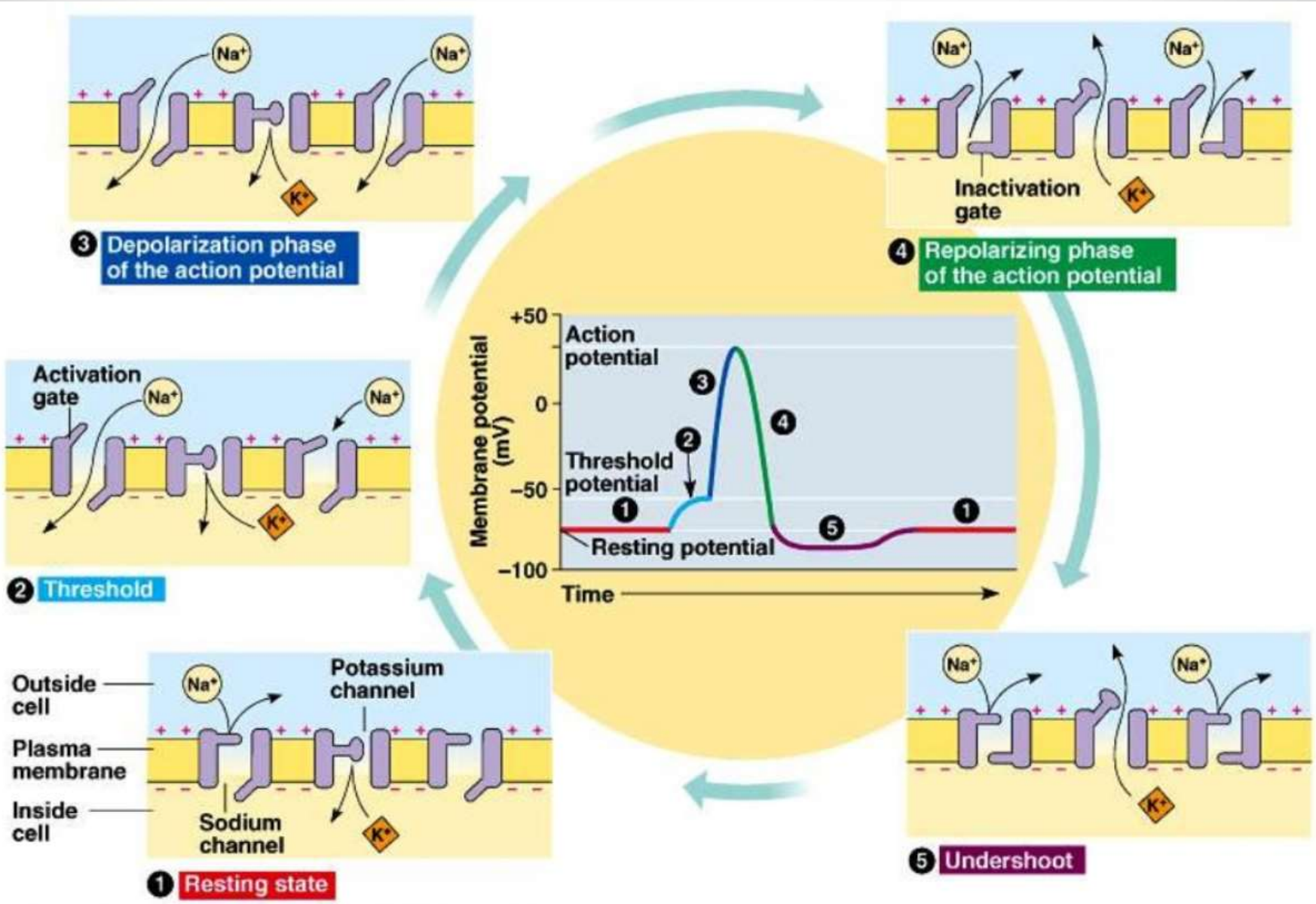




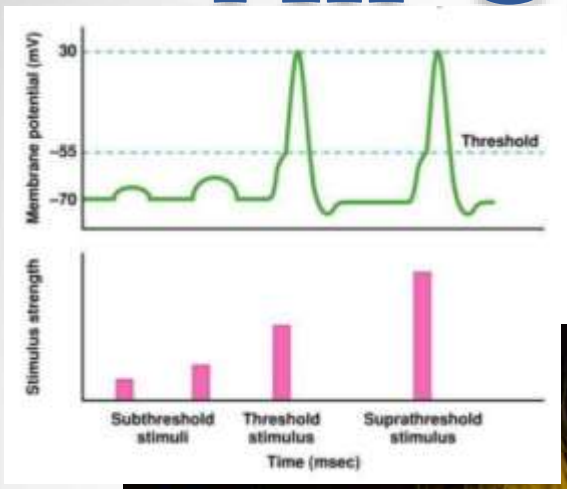
•Depolarization is brought about by a sudden change in the permeability of the membrane to Na^+. Pores in the membrane open up and let Na^+ pore in. This only lasts a brief time and the pores close up.

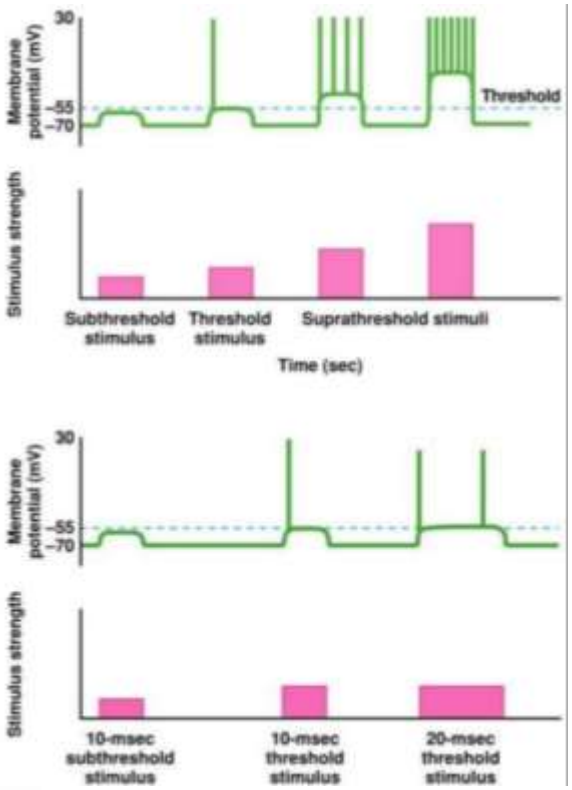
•After the depolarization wave passes. K^+ pores open up and K^+ leaves the neuron setting up a negative charge again. This resets the neuron, called repolarization.


+30 mV
0
-55 mV
-70 mV
-90 mV
2
3
Na+ Na+ K+
Sodium gates close
Na+ Na+
K+
Potassium gates open
4
Depolarization
K+
Active sodium and potassium pumps.
Na+
Na+ Na+
K+
Gate threshold
Repolarization
Stimulus
Rest potential
6
1
Na+
Na+ K+
5
Hyperpolarization
Na+ Na+ K+



All-Or-None-Response





- The action potential either fires completely or not at all.
- It won't go part way down an axon – it's all or nothing
- So you either notice something or you don't

Speed of an Impulse

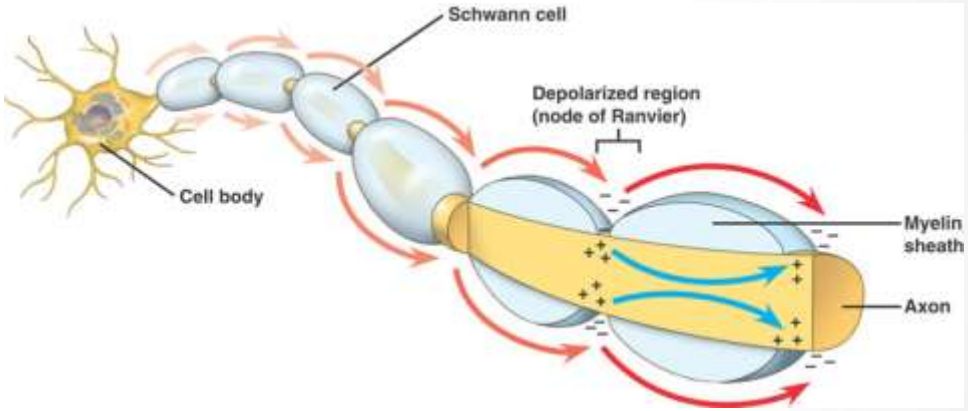
The speed of an impulse has to do with 2 things:

1. The diameter of the axon
2. If the axon is surrounded by myelin.

These can be very fast – 120 m/s (432 km/h)

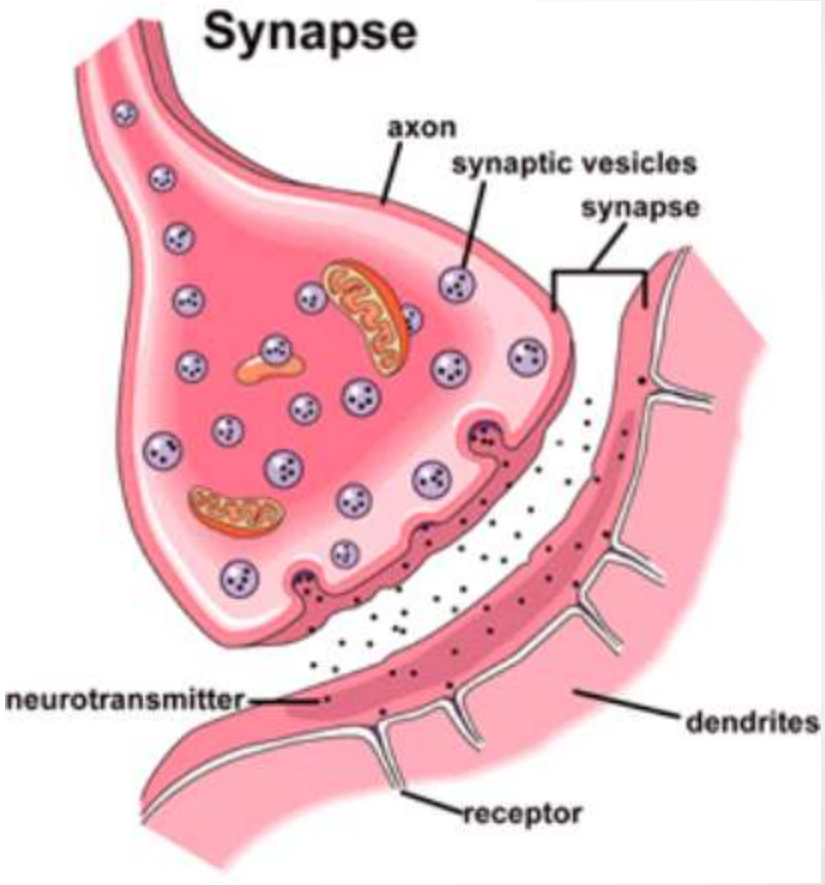
Speed of an Impulse

- When myelin is present you get saltatory conduction.
- Impulse "jumps" from node of ranvier to node.



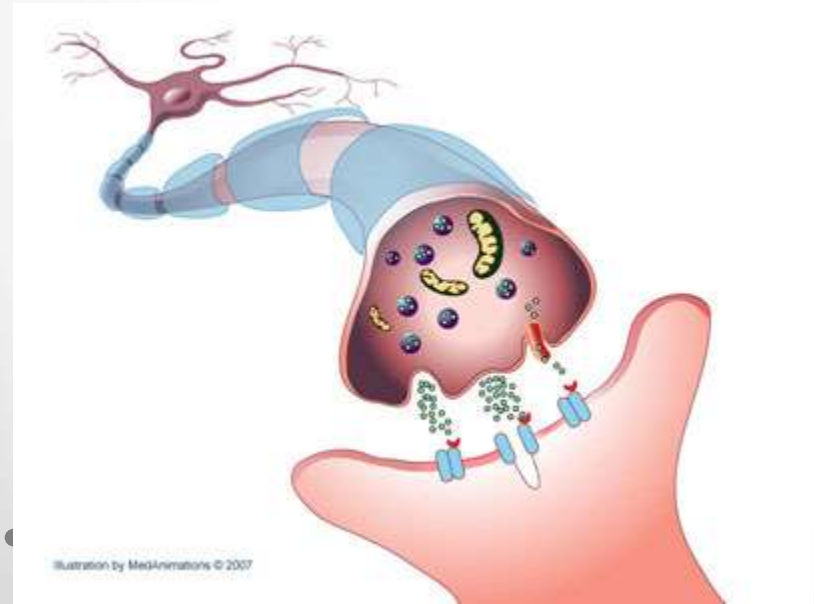
The Synapse

- Nerve pathway - nerve impulse travels from neuron to neuron
- To complete the signal, a NEUROTRANSMITTER is released at the gap to signal the next neuron



Types of Neurotransmitters

- Acetylcholine - stimulates muscle contraction
- Monoamines - Norepinephrine & Dopamine (sense of feeling good, low levels = depression)
- Serotonin (sleepiness) and mood
- Endorphins (reduce pain, inhibit receptors)



Drugs that Affect Synapses and Neurotransmitters

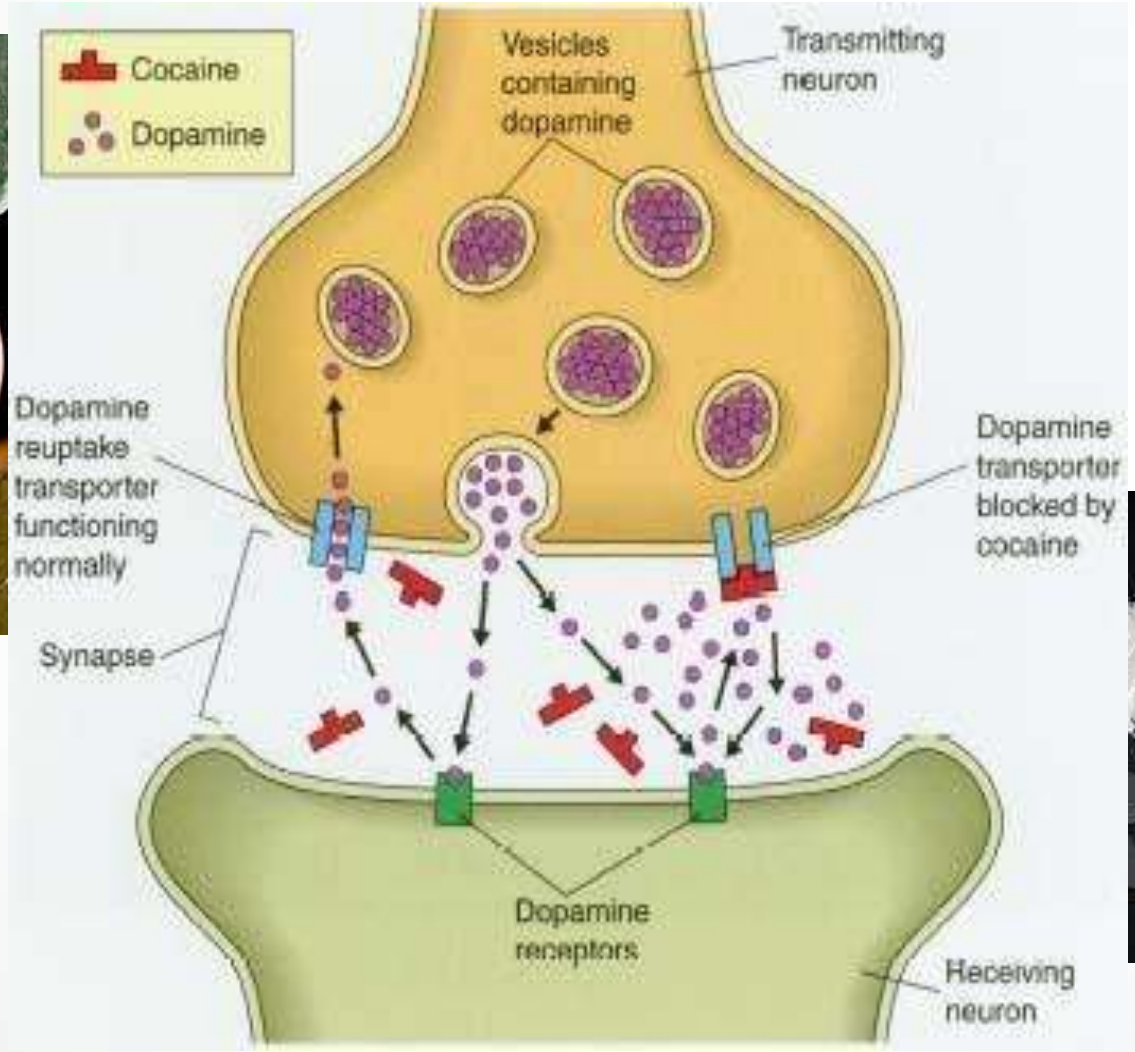
Curare - poison made from frog skin

Drugs that Affect Synapses and Neurotransmitters

- Strychnine poisoning can be fatal to humans and animals

Drugs that Affect Synapses and Neurotransmitters

- Cocaine, morphine, alcohol, ether, chloroform and Ecstasy



Antidepressants

- Zoloft is part of a class of drugs called selective serotonin reuptake inhibitors, or SSRI for short.
- SSRIs act on a specific chemical within the brain known as serotonin.