Chapter 41
Section 1

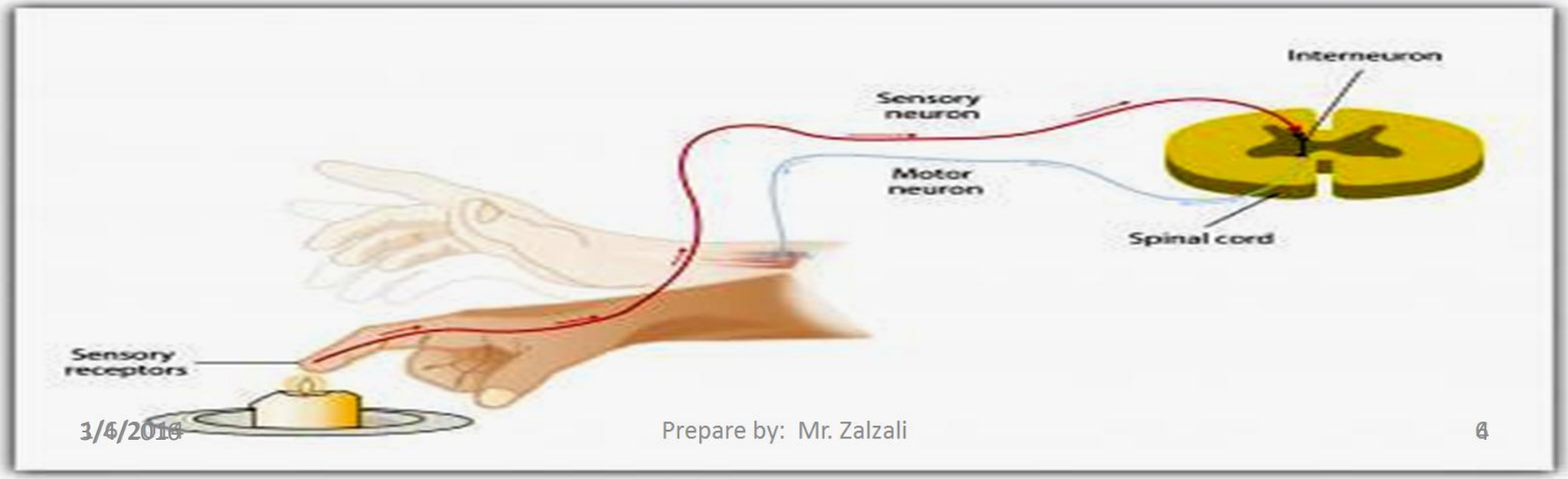
Neurons and Nerve Impulses

Neurons and impulses

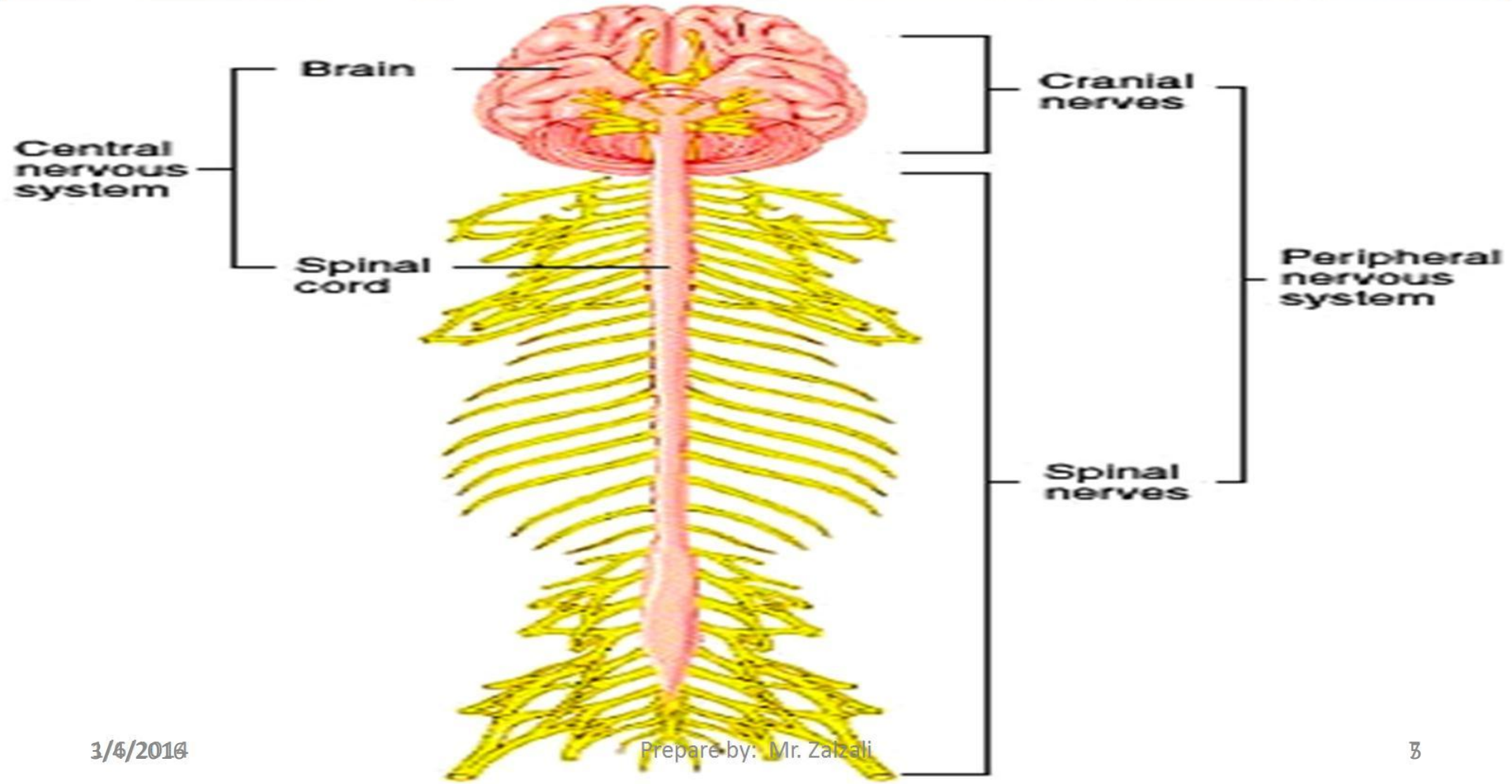
- Stimuli (stimulus = singular)
  - All changes that cause responses or reaction in living organisms.
  - Humans respond to many stim
    - 1-Light
    - 2- Sound
    - 3-Odors
    - 4-Temperatur
    - 5-Pressure
    - 6-Pain
    - 7-Touch

→ Nervous system :

- → Body system that detects and receives stimuli from environment or from inside the body and then sends electrical impulses from brain or spinal cord to all body parts to respond and react.
- → Stimuli → spinal cord and brain → respond and react.



- Parts of nervous system:
  - Central nervous system (CNS)
  - Peripheral nervous system (PNS)



- Parts of nervous system:
  - 1-Central nervous system (CNS)
    - Involves :
      - Brain → protected by the skull
      - Spinal cord → protected by the spine.
  - 2- Peripheral nervous system (PNS)
    - Involves:
      - Cranial nerves from brain
      - Spinal nerves from spinal cord

Neurons and impulses

→Nervous system(CNS & PNS) contains a complex network of nerve cells or neurons

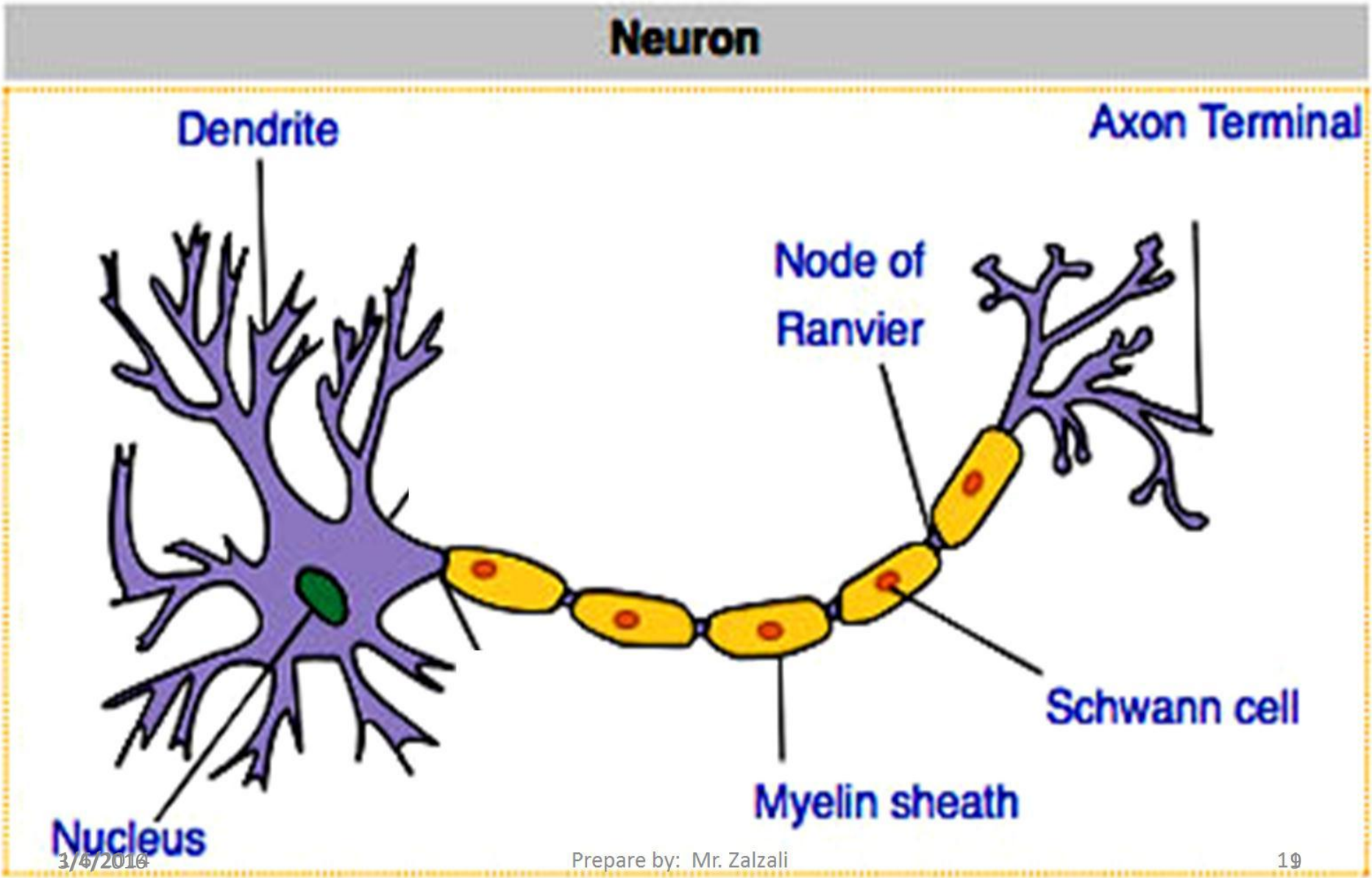
→Neurons:

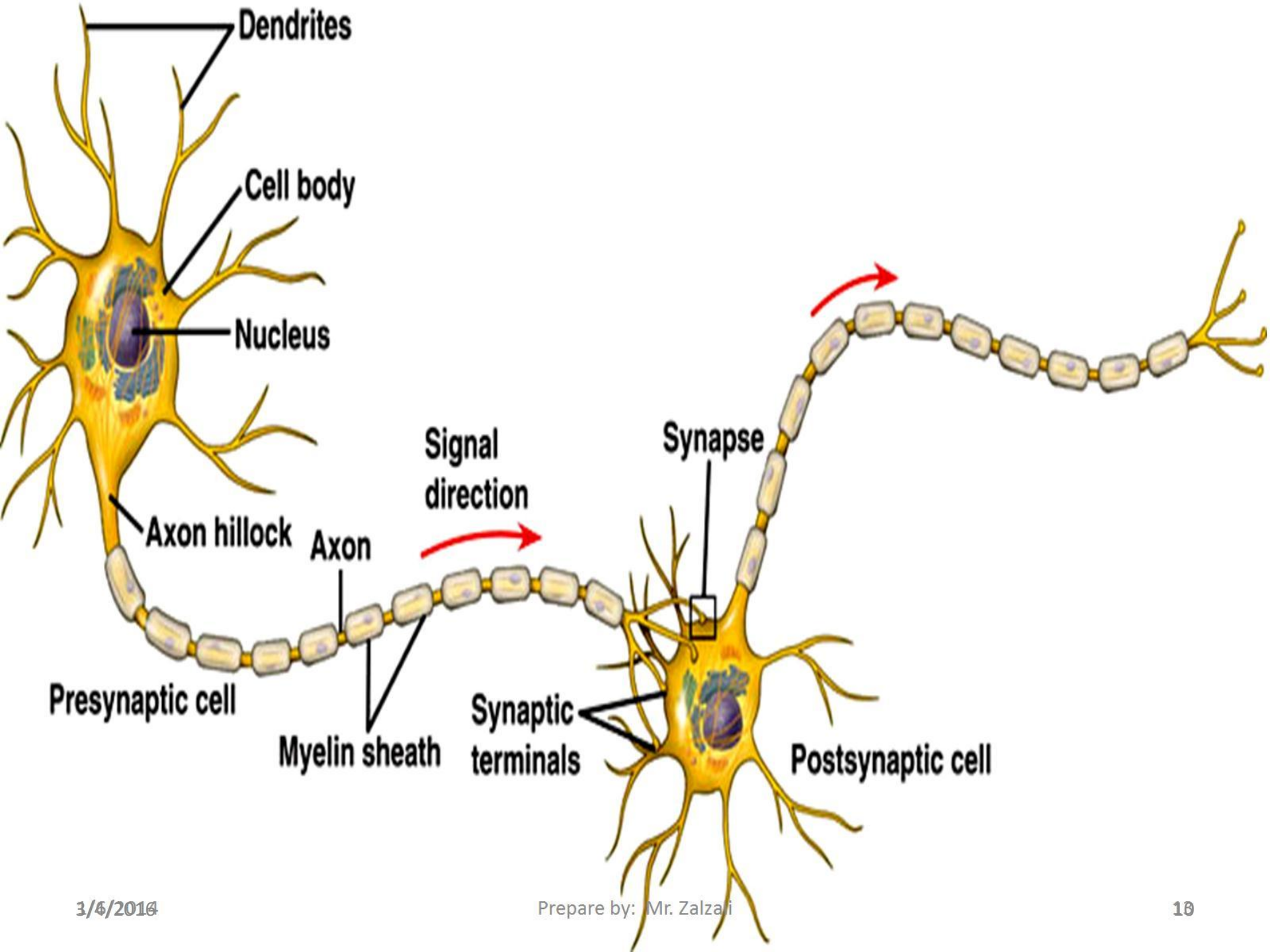
→Neurons transmit information throughout the body by creating and conducting electrical signals called *impulses* .

→Enables functions such as : movement , perception , thought, emotion, and learning


Neurons and impulses

→Myelinated neuron structure:




Dendrites
Cell body
Nucleus
Axon hillock
Axon
Signal direction
Synapse
Presynaptic cell
Myelin sheath
Synaptic terminals
Postsynaptic cell

→Main parts of neuron

	Main function
1- **Cell body**	i) **Collects electrical impulses from dendrites and pass them into axon** ii) **Allow all metabolic reactions to take place in the cytoplasm**
2- Dendrites (branches from cell body)	**- Tiny (short) extensions that receive impulses from previous neuron**
3- AXON (Nerve fiber)	**3- long-membrane covered extension which transmit or conduct electrical impulses to next neuron**

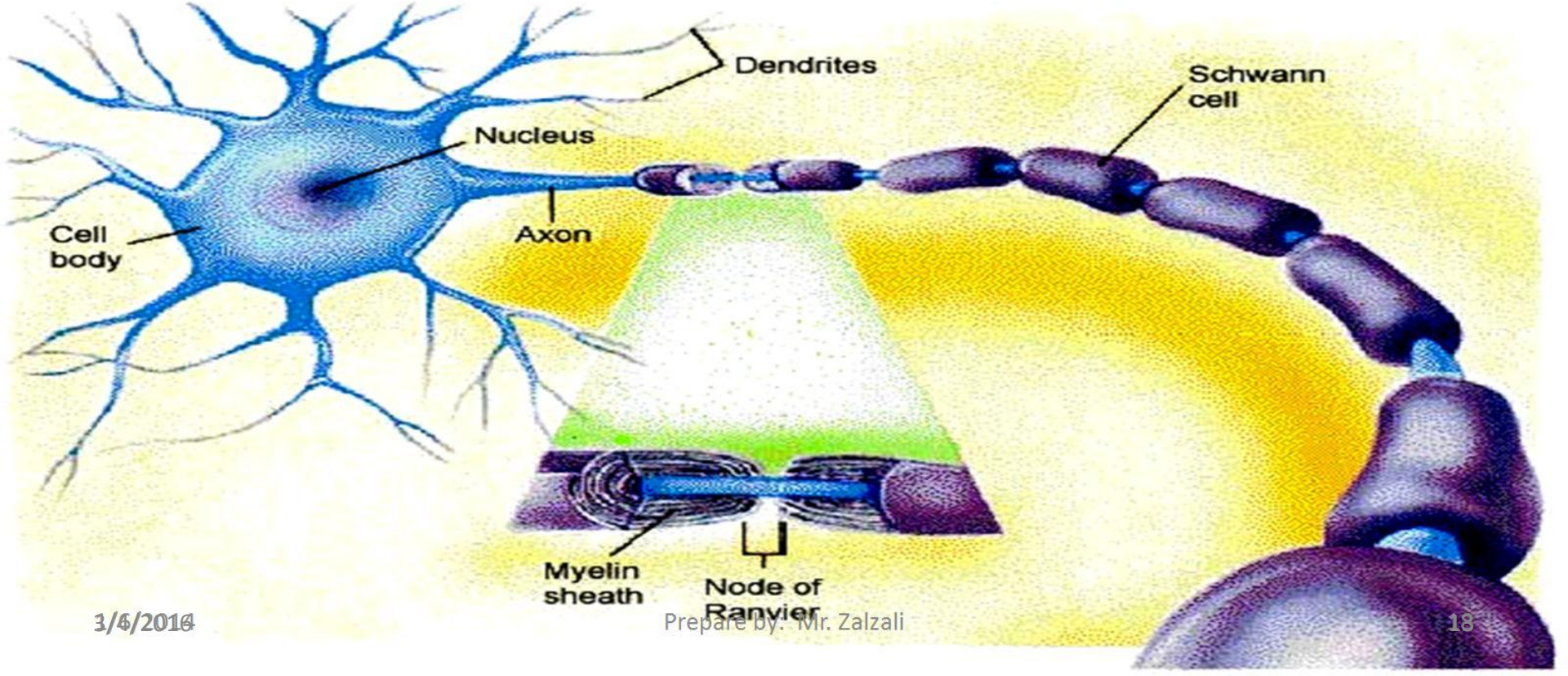
	Main function
4- myelin sheath	4- a fatty substance around the axon and produced by special cells called "Schwann cells" -**Function :** -a fatty substance around the axon to allow nerve impulses to pass to terminal endings of neuron -Speed up transmission of nerve impulses along the axon
5- Terminal endings (nerve endings)	5- transmit nerve impulses to : -next neuron - Or to a muscle to respond and contract -or To a gland to secrete hormones.
Node of Ranvier	-Allow transmission of electrical impulses.

→ **The speed of electrical (nerve) impulse increases in neurons with:**

→ Larger diameter

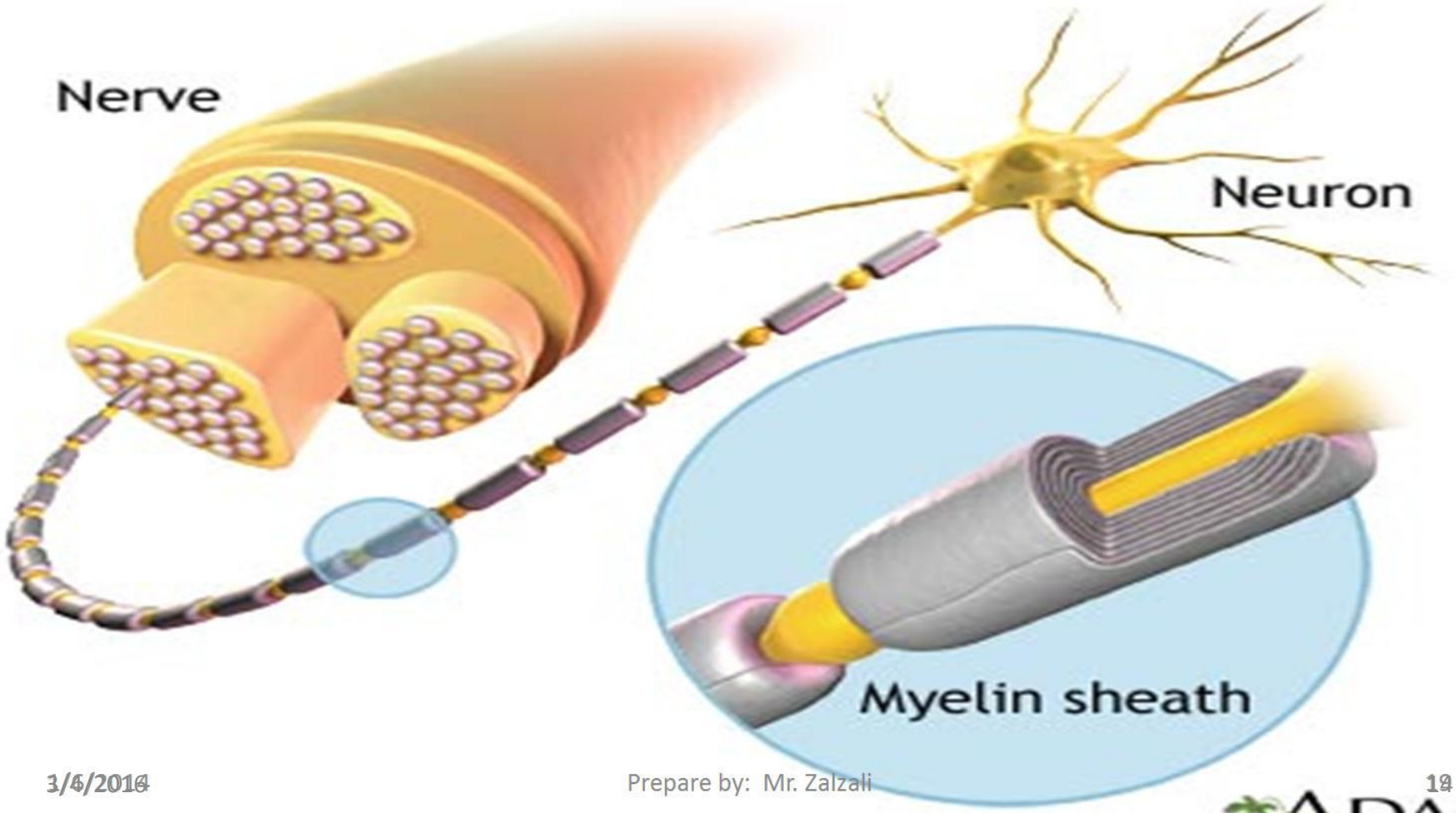
→ Mylinated axon:

→ because nerve impulses "jump" from node to node as they move down the axon.

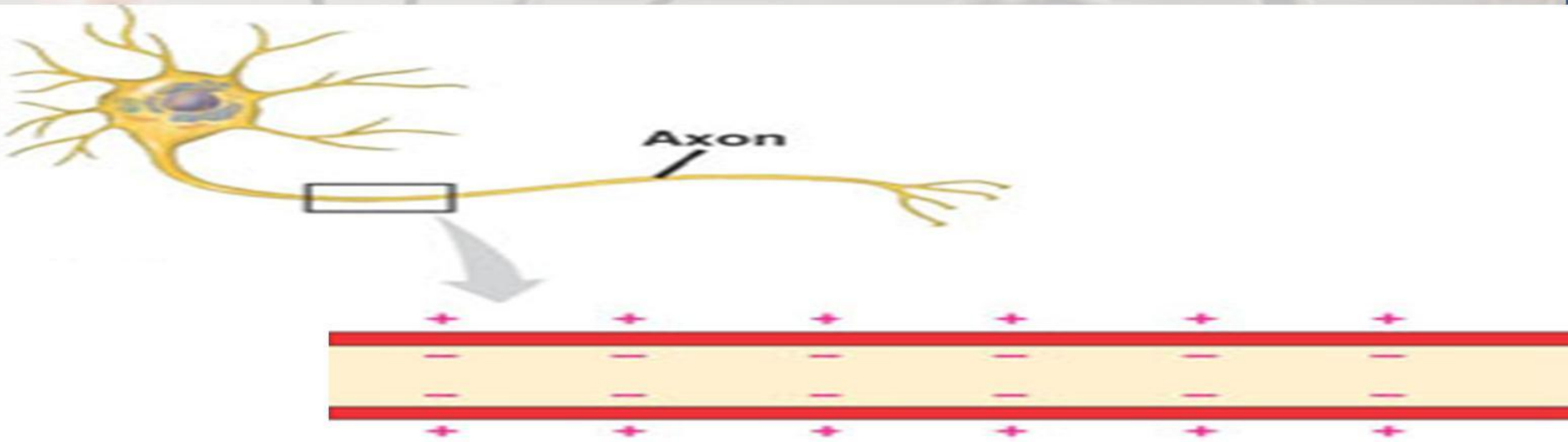


→ Nerve:

→ is a bundle of many neurons AXONS that appears as white fine threads.



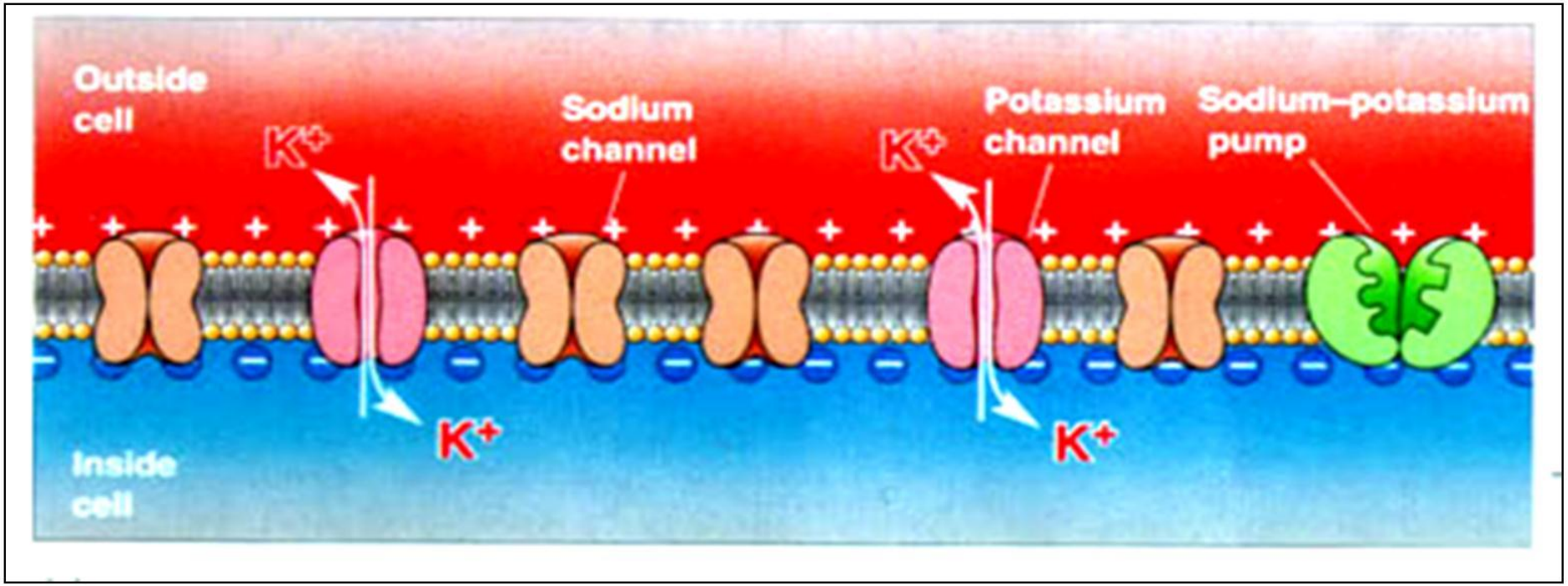
→Membrane potential



→Membrane potential

- →The difference in electrical charge across the cell membrane
- → results from movement of ions into and out of the cell
- →Expressed as voltage.

→Resting potential.

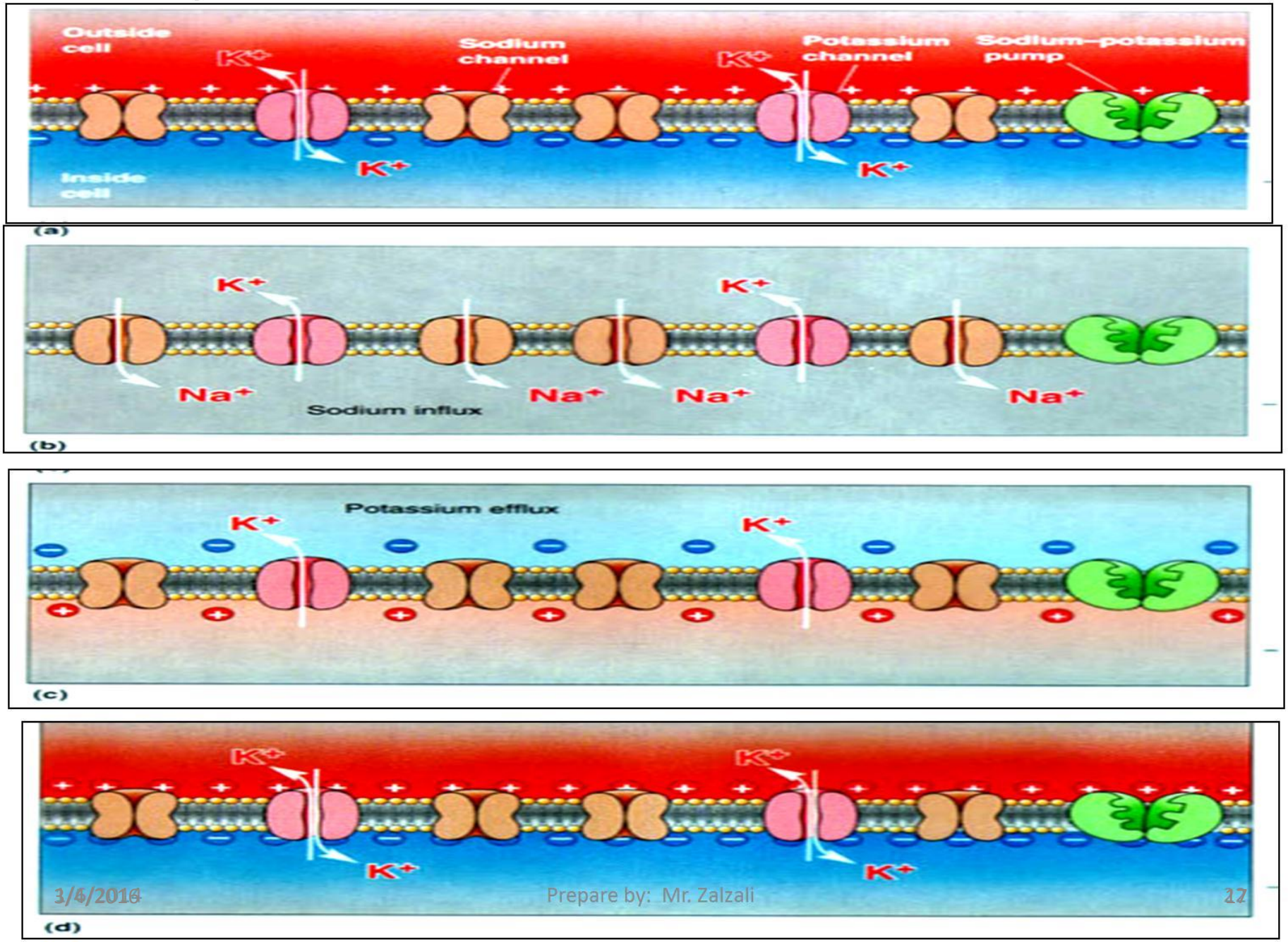


→Resting potential:

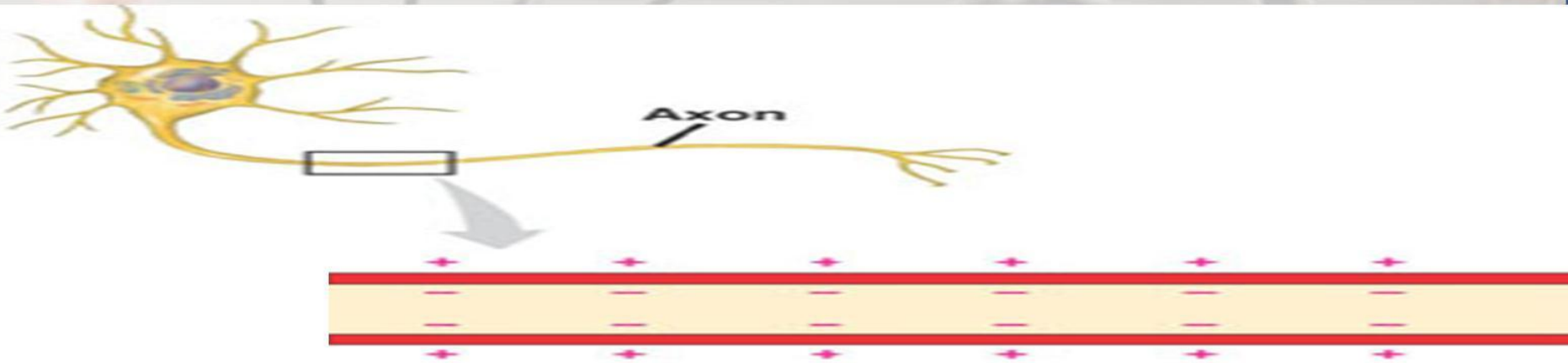
→The outside is positively charged due to the Na+

→ the inside of the cell is negatively charged due to negatively charged proteins.

Action potential



→Membrane potential

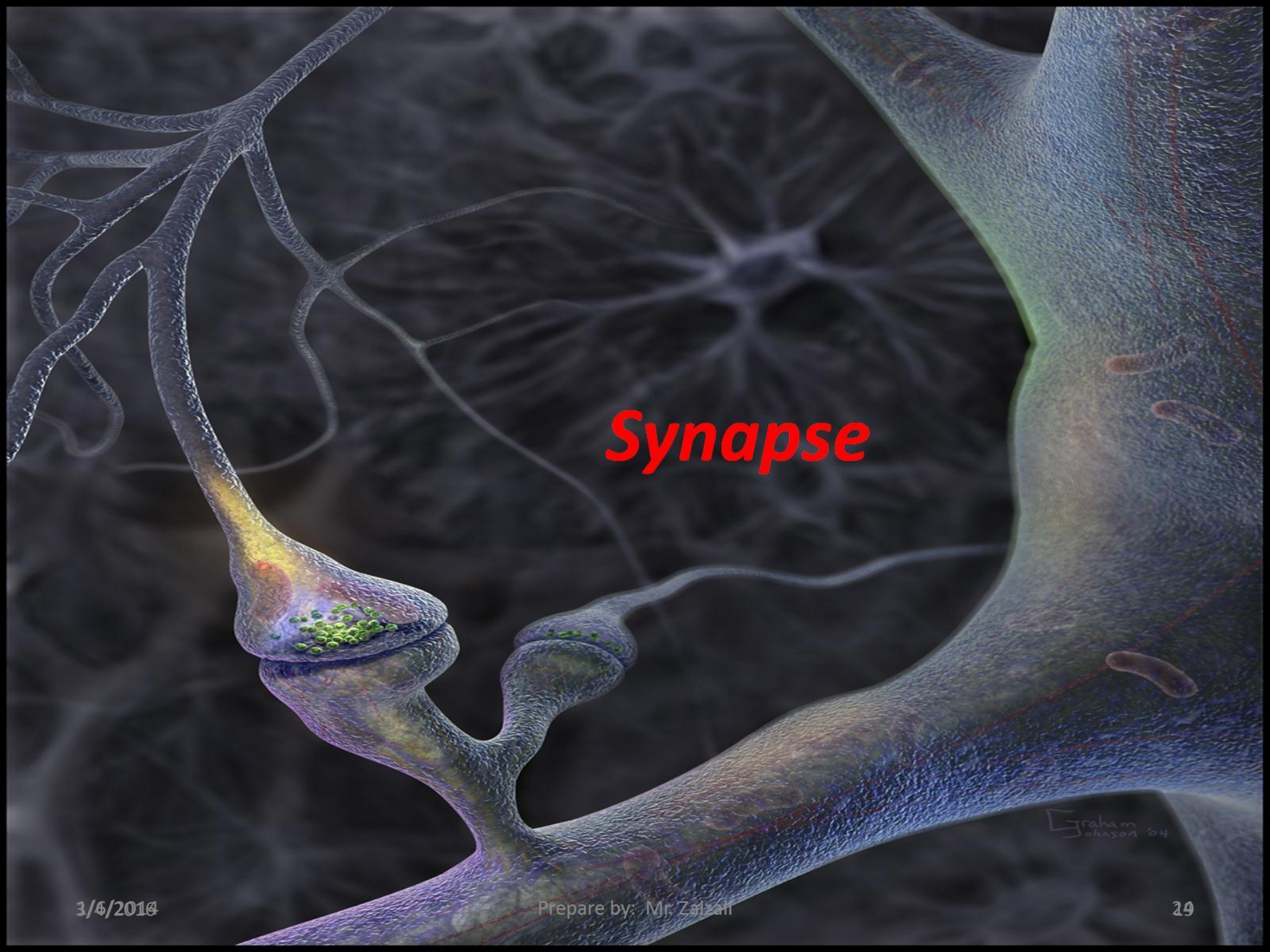


→Resting potential: (-70 mV)

- → membrane potential of a neuron at rest.(no stimulus)
- → Neuron is not conducting a nerve impulse
- → The inside of the neuron is negatively charged

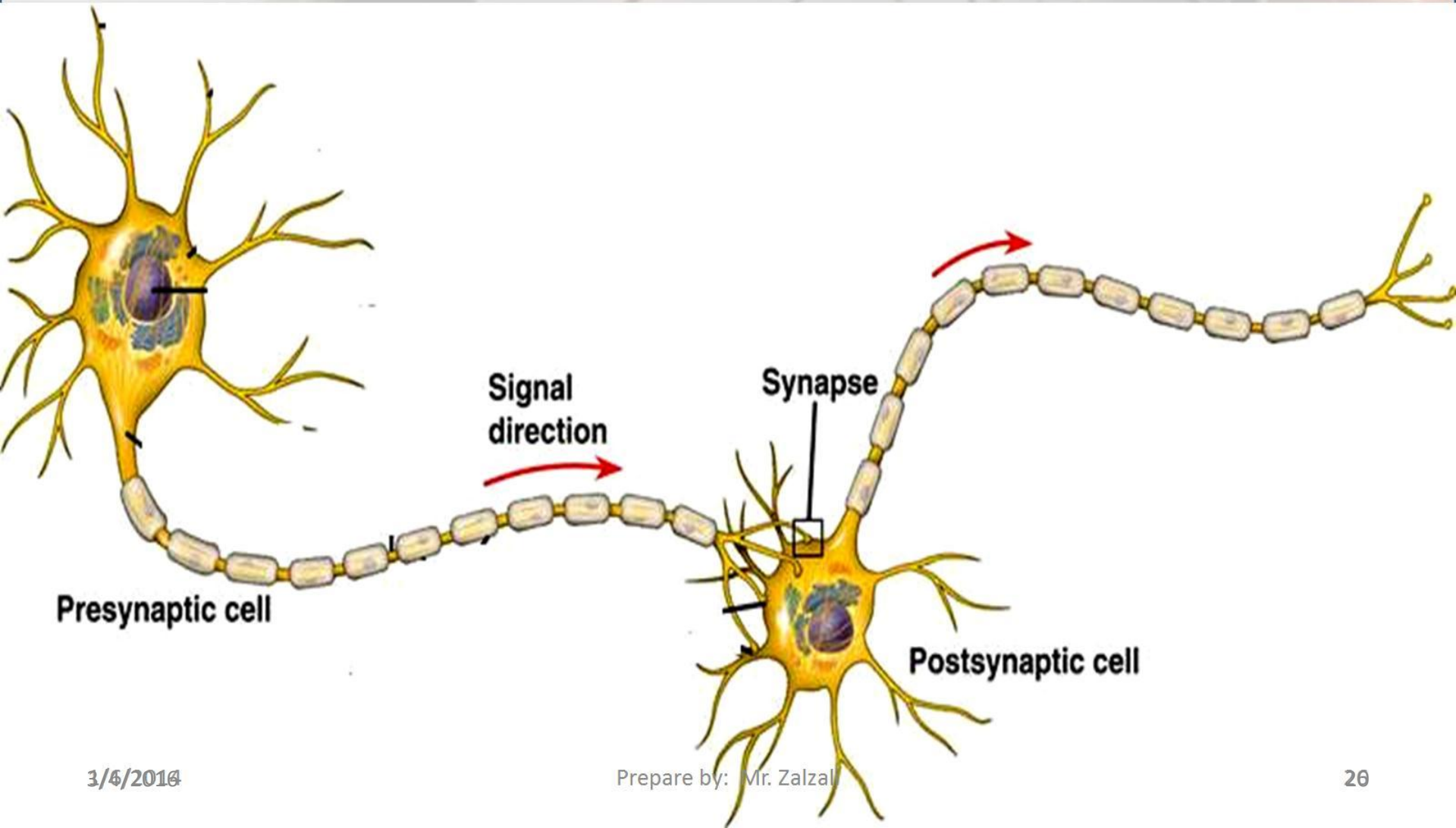
→Action potential (nerve impulse) :

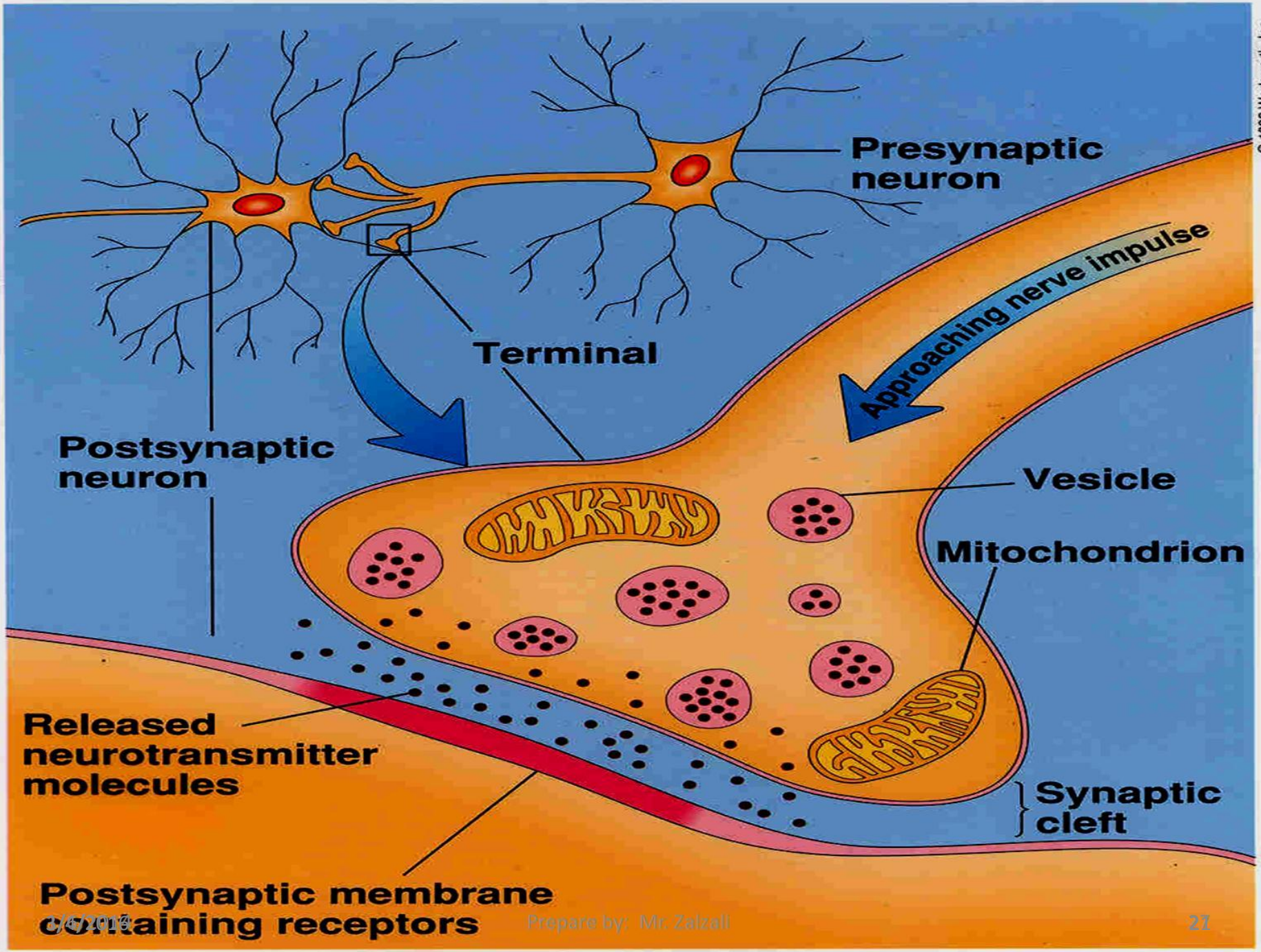
- → Reversal of polarity from a negative to a positive charge inside the neuron
- → A stimulus (light – heat- odor-pain …) causes an action potential.

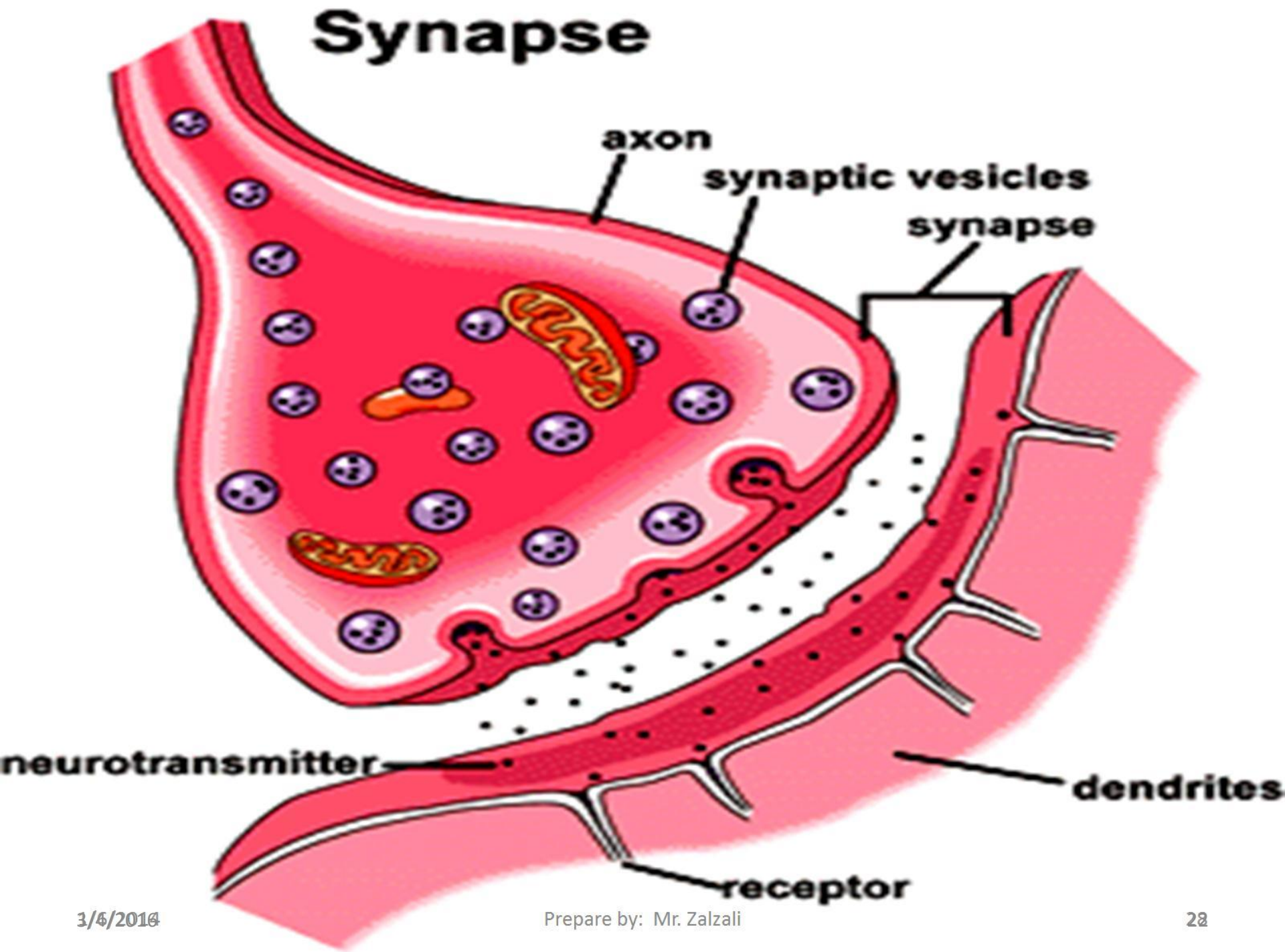

Synapse

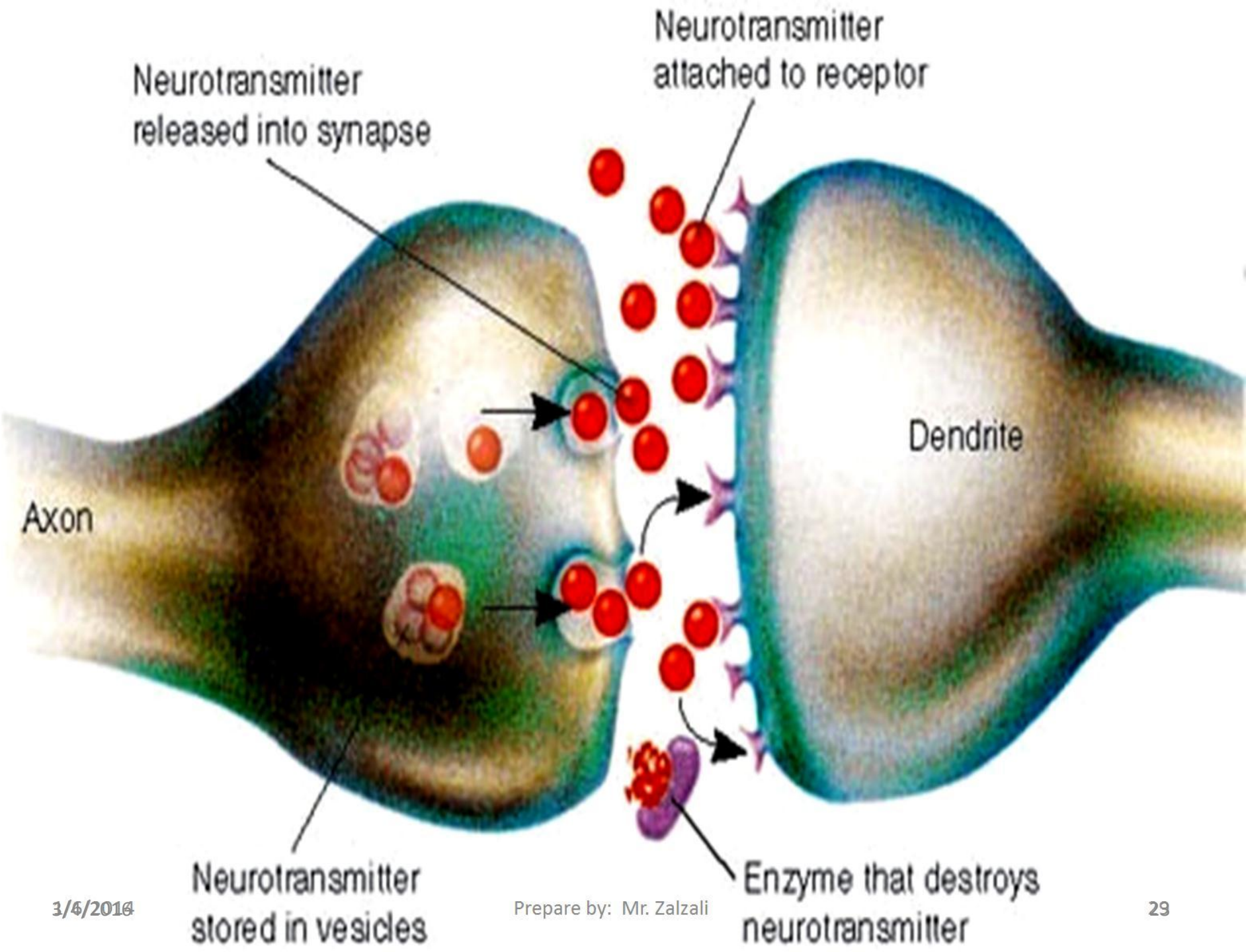
→Communication between neurons:

→*Synapse* : the junction at which signals are transmitted between a neuron and another cell




Presynaptic neuron
Approaching nerve impulse
Terminal
Postsynaptic neuron
Vesicle
Mitochondrion
Released neurotransmitter molecules
Synaptic cleft
Postsynaptic membrane containing receptors
© 1992 Wadsworth, Inc.


Synapse
axon
synaptic vesicles
synapse
neurotransmitter
dendrites
receptor


Neurotransmitter released into synapse
Neurotransmitter attached to receptor
Dendrite
Axon
Neurotransmitter stored in vesicles
Enzyme that destroys neurotransmitter

→Synapse

→**Synaptic cleft :**

→The gap between the axon terminal and the next neuron

→ **pre-synaptic neuron:**

→The transmitting neuron, sending impulses to the synapse.

→**Post-synaptic neuron:**

→The receiving neuron, send impulses away from the synapse

→**Neurotransmitters : (acetylcholine, adrenaline)**

→ the chemical signals released by neurons at synapse (glutamate , dopamine)

→ ***Synapse***

→ ***What are the steps of synaptic transmition of a nerve impulse ?***

→ 1- the nerve impulse with electrical nature arrives the axon terminal of the pre-synaptic neuron

→ 2- **neurotransmitters are released from pre-synaptic neuron to the synaptic cleft.**

→ 3-Neurotransmitters cross the synaptic cleft to interact or bind with the receptors of the post-synaptic neuron

→ **4- neurotransmitters change the activity of the next post-synaptic either by exciting or inhibiting the next cell**

→ ***Synapse***

→ ***What happens to neurotransmitters after binding on the receptors of the post-synaptic neurons?***

→ Neurotransmitters are removed from the synaptic cleft by one of the two ways:

- → 1- they could be broken down by enzymes.
- → 2- OR reabsorbed back to the pre-synaptic neuron to be used again.

→ Note: