



جامعة المستقبل
AL MUSTAQBAL UNIVERSITY
كلية العلوم

قسم الأنظمة الطبية الذكية

General Anatomy and Physiology

(L3) Membrane Physiology, Nerve, and Muscle

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WHAT IS CELL MEMBRANE ?

- ✓ The cell membrane (also called the *plasma membrane*) is a biological membrane separating the interior of a cell from the outside environment
- ✓ It appears in thin sections with the electron microscope as a triple-layered structure about 7.5–10 nanometers thick

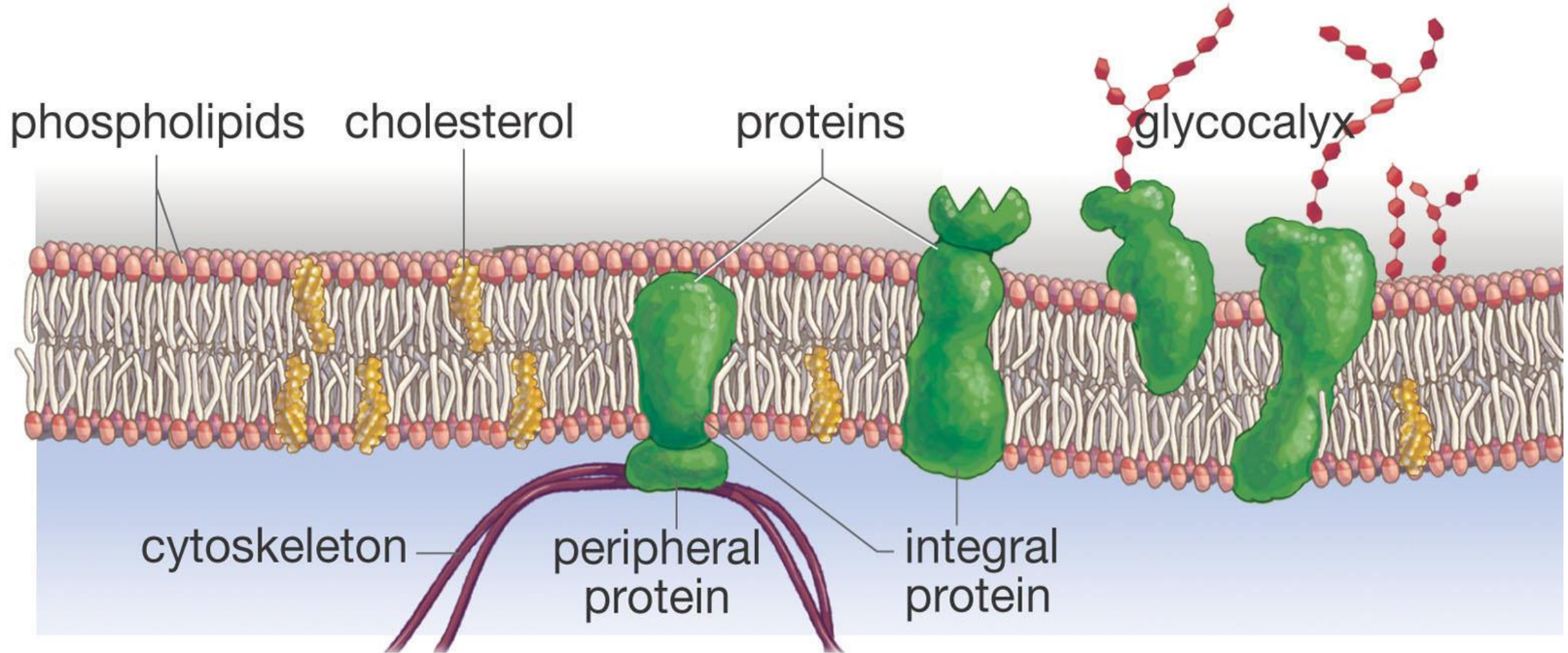
CHEMICAL COMPOSITION

1. Lipids : are commonly present in the plasma membrane.

2. Proteins-plasma membrane contains about 50% protein. Amount and type is variable.

Plasma membranes contains structural proteins, transport proteins and enzymes. Some of them acts as receptors.

3. Carbohydrates: they are present in the plasma membrane.



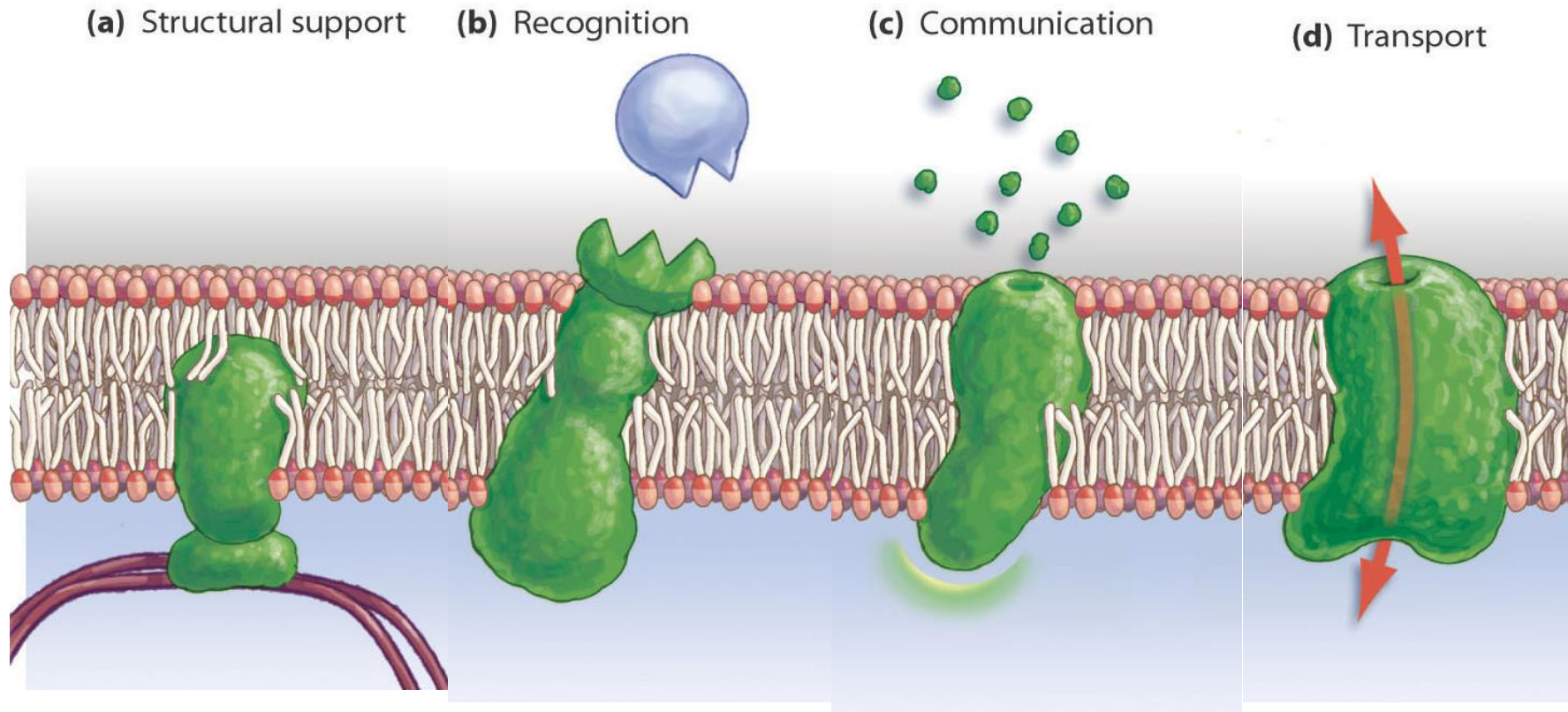
● Phospholipid bilayer

● Cholesterol

● Proteins

● Glycocalyx

PROTEINS ARE CRITICAL TO MEMBRANE FUNCTION



Nerve and Muscle:

The nervous system is a major communicating and control system within the body. It works with the **endocrine system** to control many body functions.

Organisation of the nervous system

The nervous system can be divided into two parts:

the central nervous system CNS and the **peripheral nervous system PNS**.

The central nervous system consists of the **brain** and **spinal cord** and is the control and integration centre for many body functions.

The peripheral nervous system carries **sensory** information to the central nervous system and **motor** information out of the central nervous system. The direction of information flow to and from the nervous system is important and is shown in Figure.

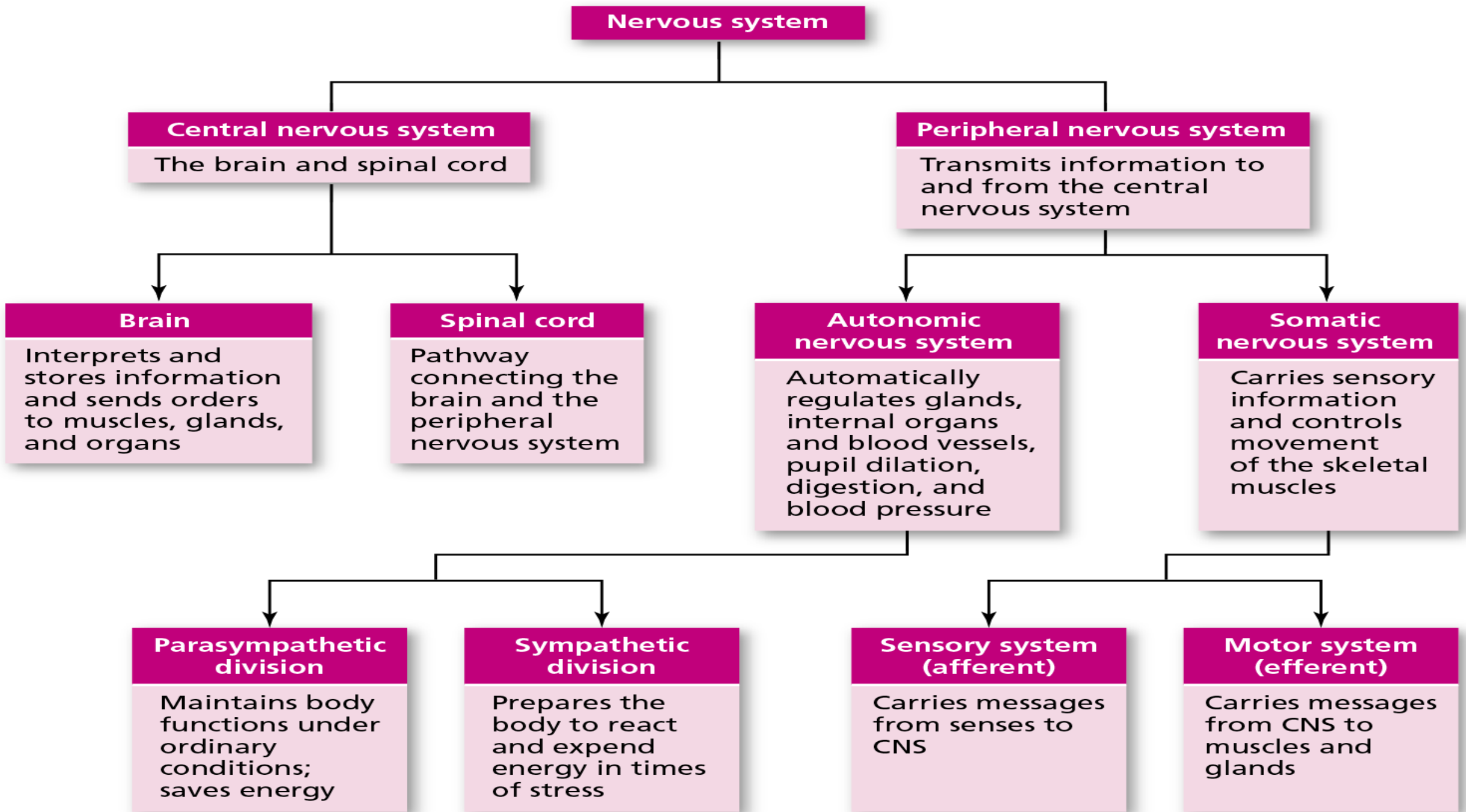
Sensory division of the peripheral nervous system

Sensory information (stimuli) is gathered from both inside and outside of the body. This sensory input is delivered to the central nervous system via the peripheral nerves.

Sensory nerve fibers are also called **afferent fibers**. Sensory information always travels from the peripheral nervous system towards the central nervous system.

Motor division of the peripheral nervous system

The motor division of the peripheral nervous system always carries impulses away from the central nervous system, usually to effector organs. Motor nerve fibres are also called **efferent** fibres.



Neurons

The functional unit of the nervous system is the neuron or nerve cell. It has many features in common with other cells, including a nucleus and mitochondria, but because of its vital role it is well protected and has some specialist modifications. Two specialist characteristics of neurons are:

- **irritability**, in response to a stimulus – the ability to initiate a nerve impulse.
- **conductivity** – the ability to conduct an impulse. Neurons consist of an axon, dendrites and a cell body. Their function is to transmit nerve impulses.

Nerve impulses only travel in one direction: from the receptive area, the dendrites, to the cell body, and down the length of the axon.

Dendrites

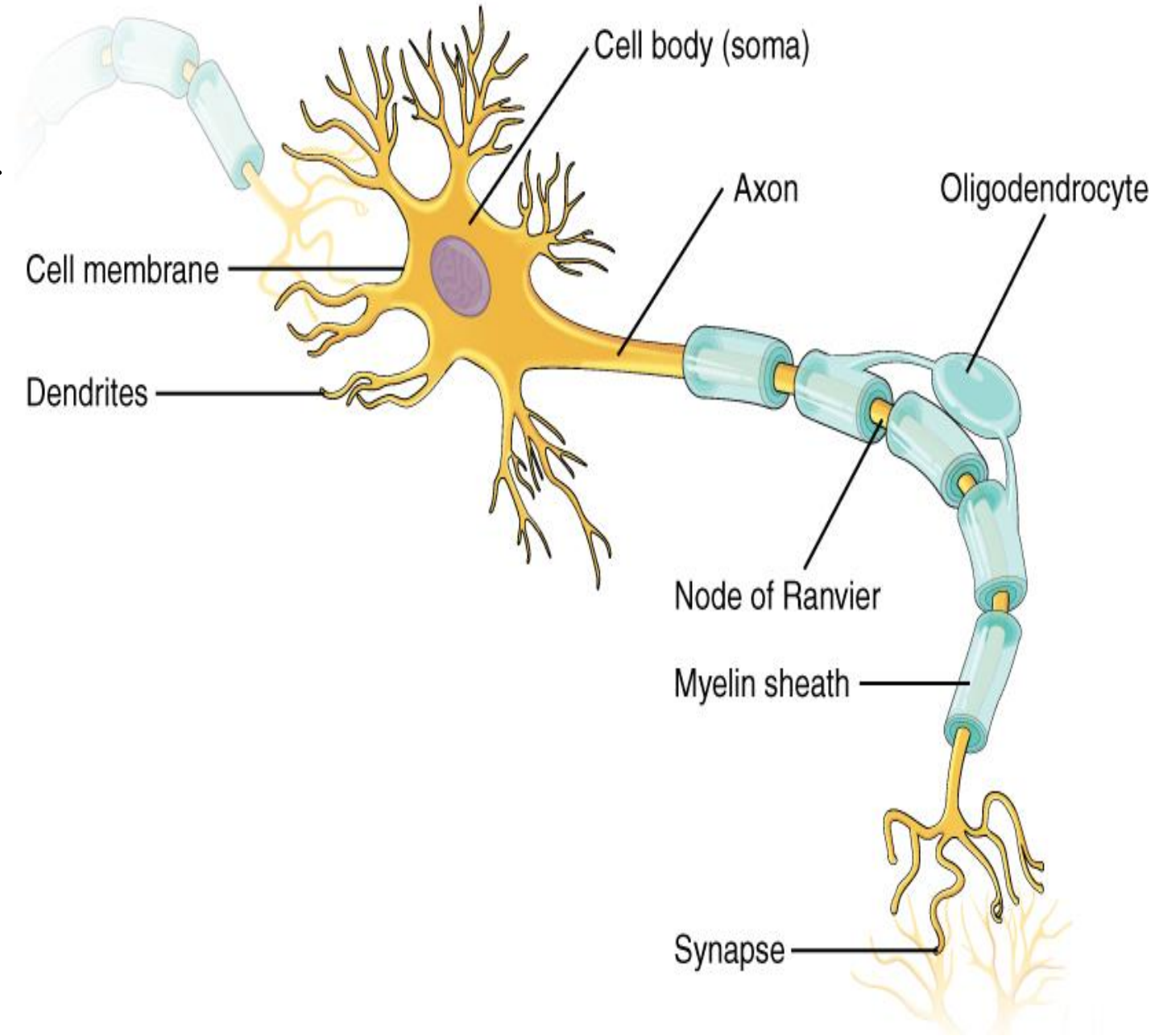
Dendrites are short branching processes that receive information and conduct it toward the cell body. can form part of the synapse between one neuron and the next.

Cell body

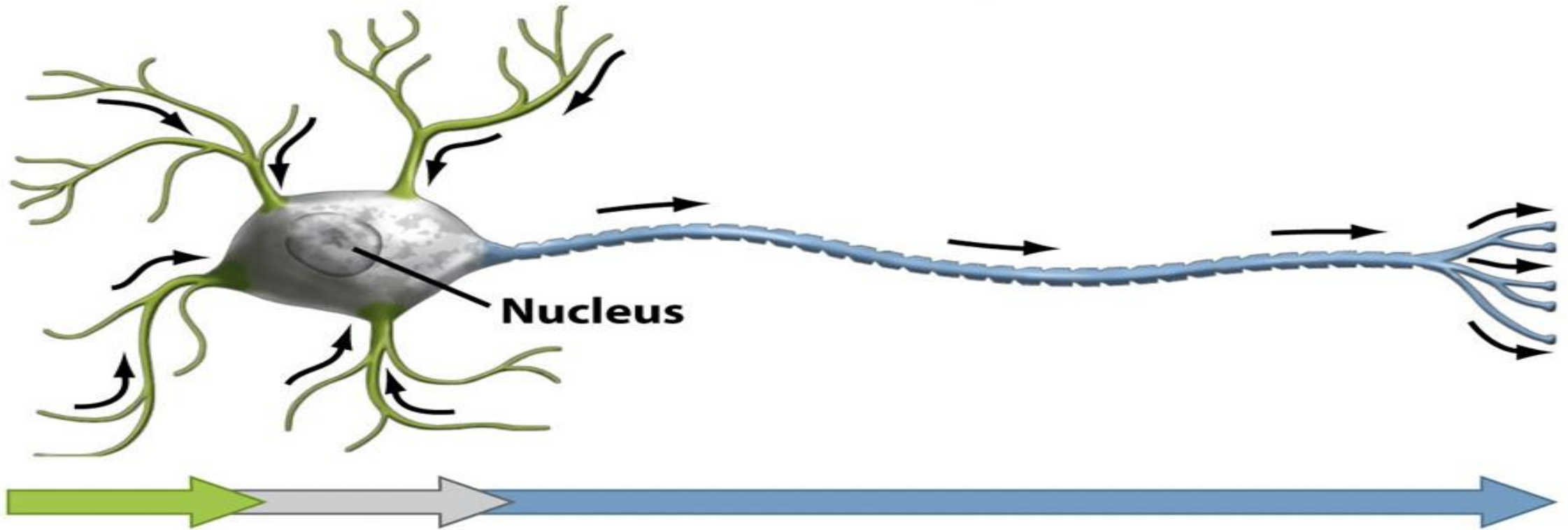
Most of the neuron cell bodies are located inside the central nervous system and form the grey matter..

Axons

Each neurone has only one axon that conducts information away from the cell body. The axon will branch at its terminal into many axon terminals. The axon delivers the impulse to another neuron or a gland



Information flow through neurons



Dendrites
Collect
electrical
signals

Cell body
Integrates incoming
signals and generates
outgoing signal to
axon

Axon
Passes electrical signals
to dendrites of another
cell or to an effector cell

Muscle is a soft tissue

Muscle cells contain protein filaments of actin and myosin

Types of Muscle

- a. Skeletal Muscle;
- b. Smooth Muscle; and
- c. Cardiac Muscle

Characteristics of Muscle

Excitability: ability to receive and respond to stimulus;

Contractility: ability to shorten when adequate stimulus is received;

Extensibility: ability of muscle to be stretched; and

Elasticity: ability to recoil and resume resting length after stretching

Synapses: are the gaps between adjacent neurons across which chemical signals are transmitted.

Synaptic vesicles: small spherical membranes that store neurotransmitter molecules and release them into synaptic cleft.

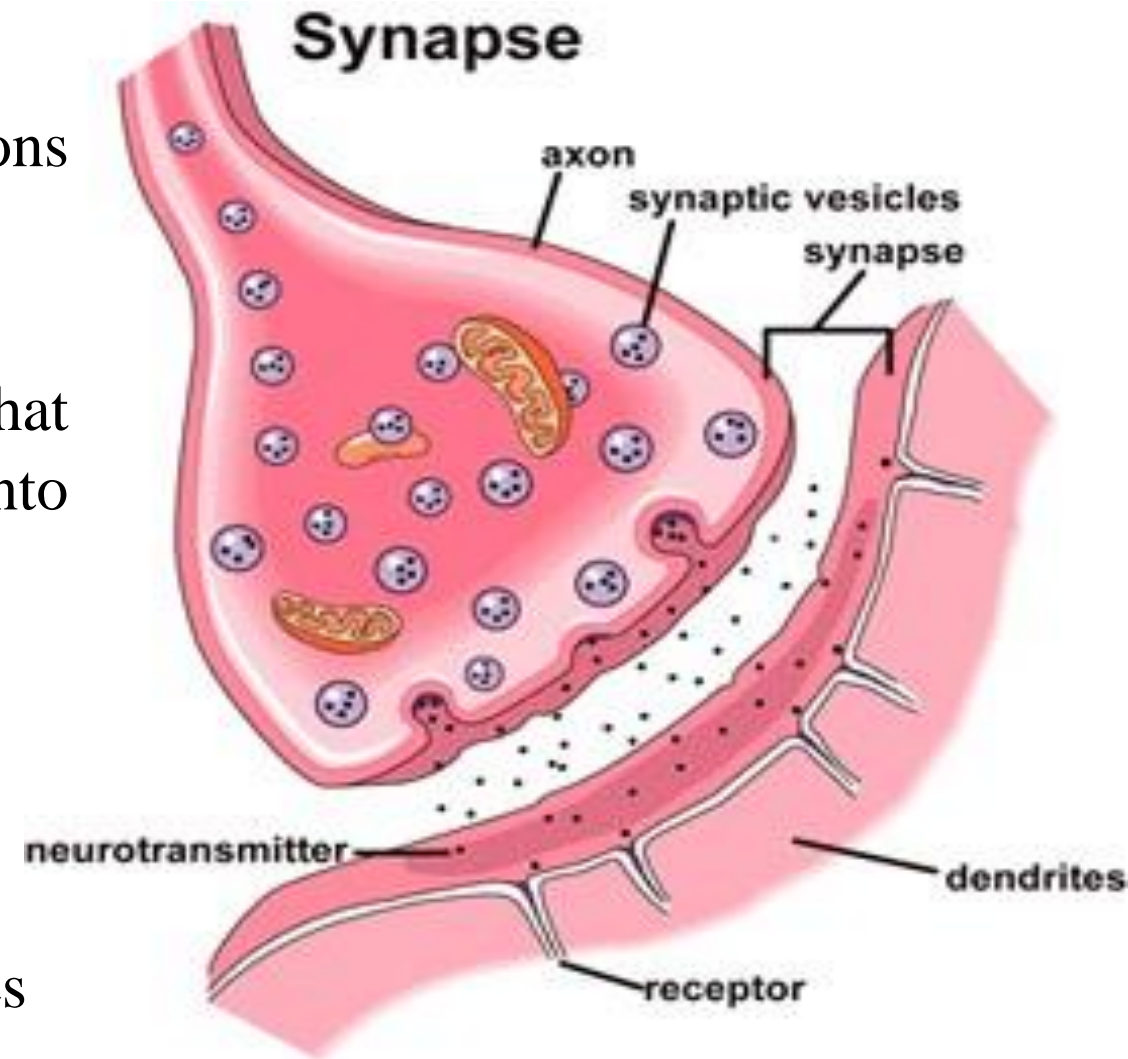
Neurotransmitters

Neurons do not come into contact with one another.

Where one neuron ends and another begins, there is a space called the synapse.

In order for communication to occur between neurones or between the neurone and a muscle or gland, a chemical messenger called a **neurotransmitter** is secreted by the neurone. Like:

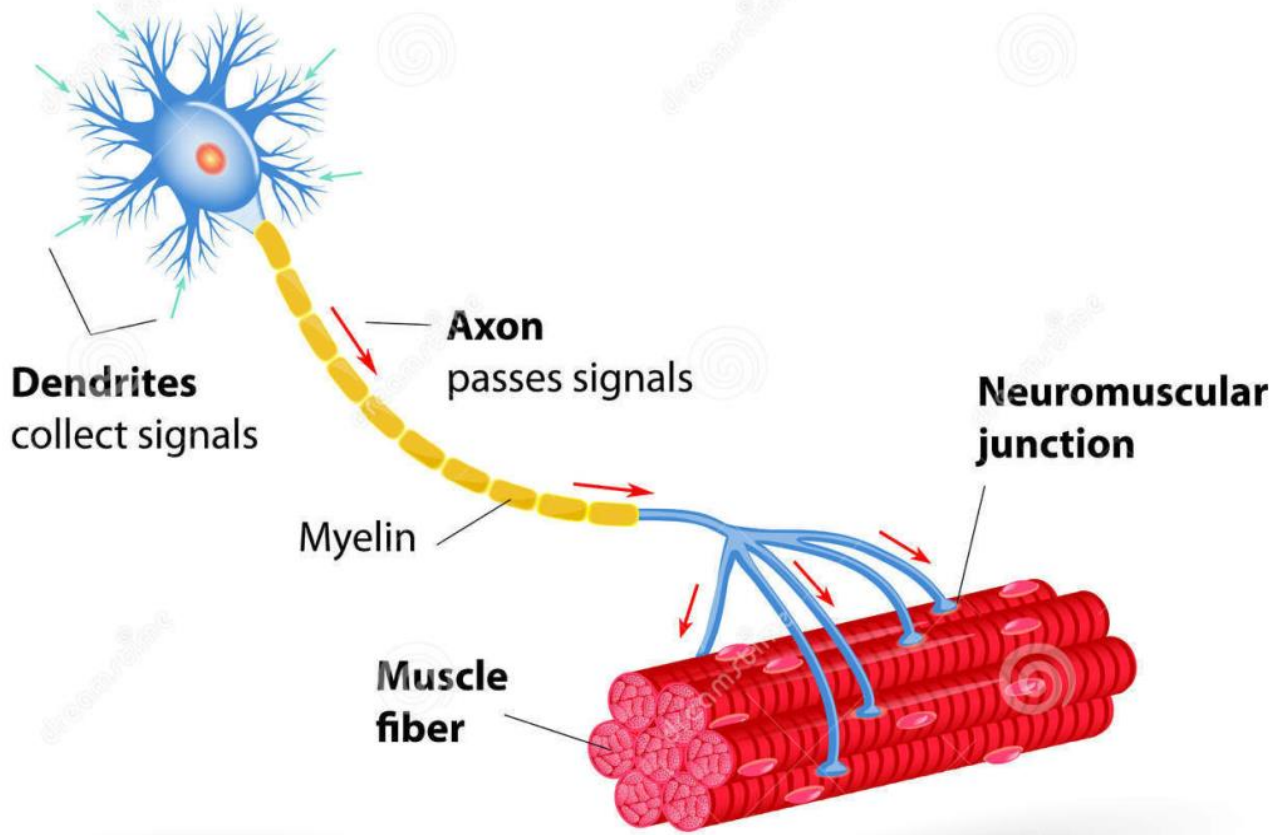
Acetylcholine norepinephrine dopamine.



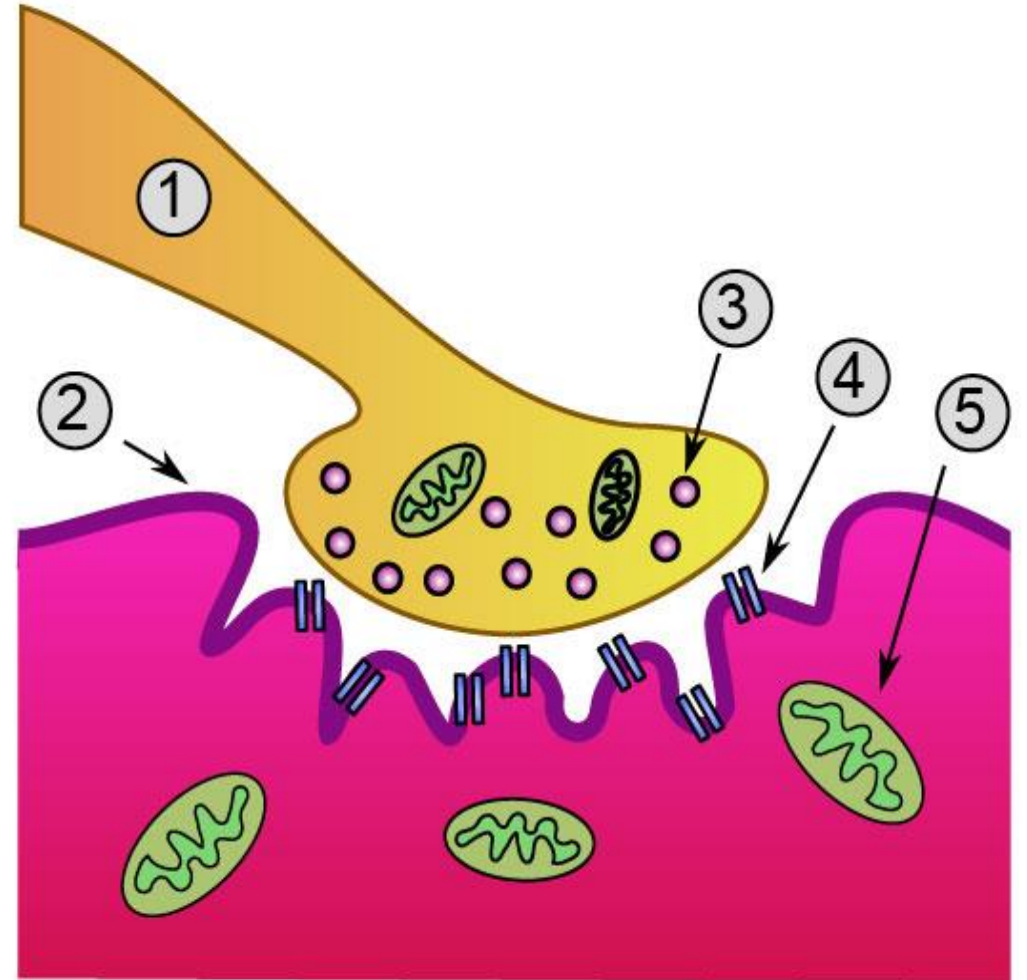
Physiology of at Neuromuscular Junction

- Branching nerve terminals invaginate into the surface of the muscle fibre but lie outside it.
- Hence the synaptic cleft
- Usually around 20-30 nm
- Ach(Acetyl choline) is **the neurotransmitter at** Neuromuscular Junction
- the neurotransmitter receptors on the post junctional membrane
- Acetylcholine molecules that don't interact with receptors are released from the binding site & are destroyed almost immediately by acetylcholinesterase, in <1 ms, after its release into the junctional cleft.
- This **acetylcholinesterase** is protein enzyme secreted from the muscle.

MOTOR NEURON



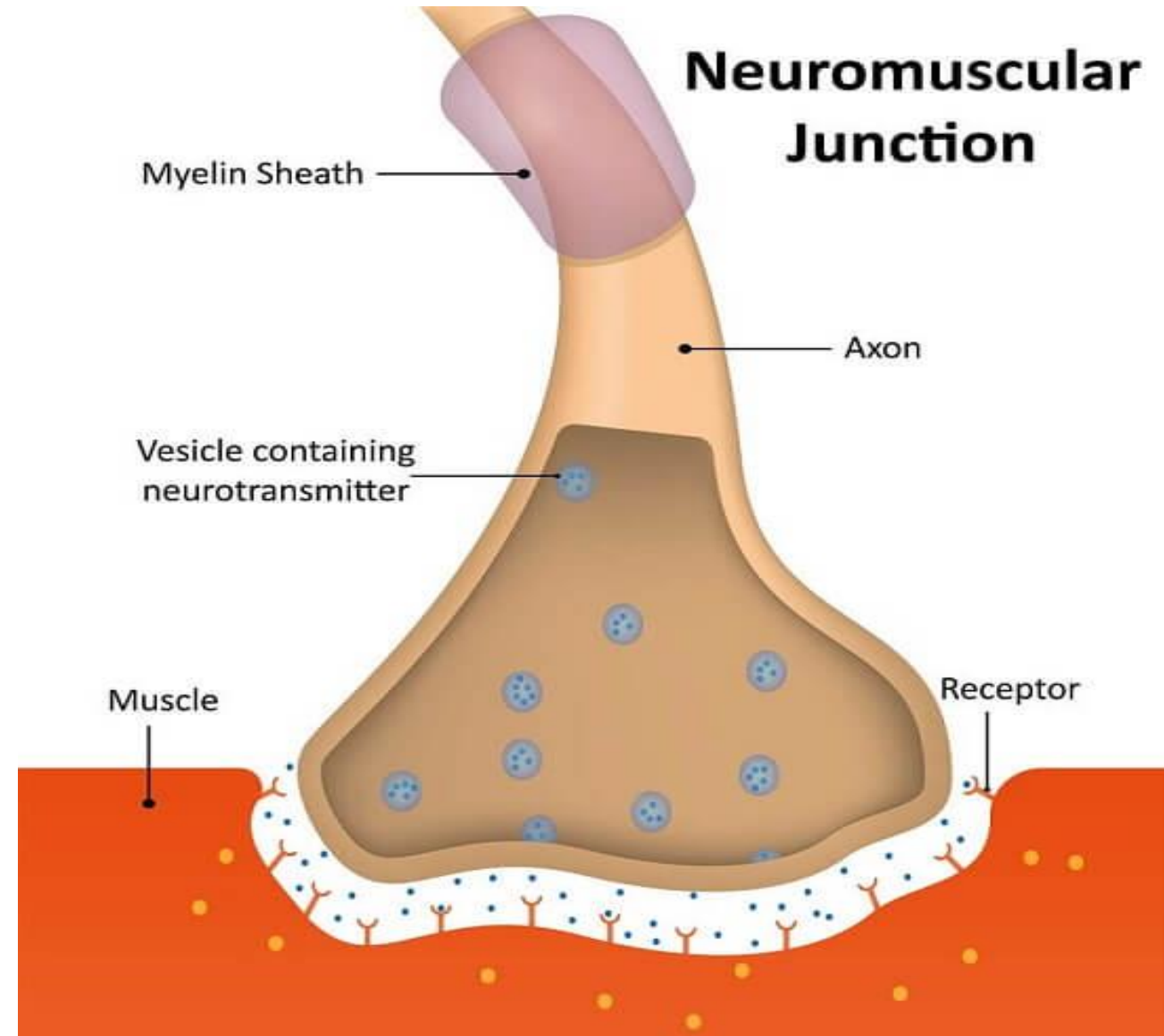
1. Neuromuscular junction (closer view)
3. Sarcolemma
5. Acetylcholine receptors



2. presynaptic terminal
4. synaptic vesicles
- mitochondrion

The structure of NMJ (NeuroMuscular Junction) can be divided into three main parts:

1. a presynaptic part (nerve terminal)
2. the postsynaptic part (motor endplate)
3. an area between the nerve terminal and motor endplate (synaptic cleft).



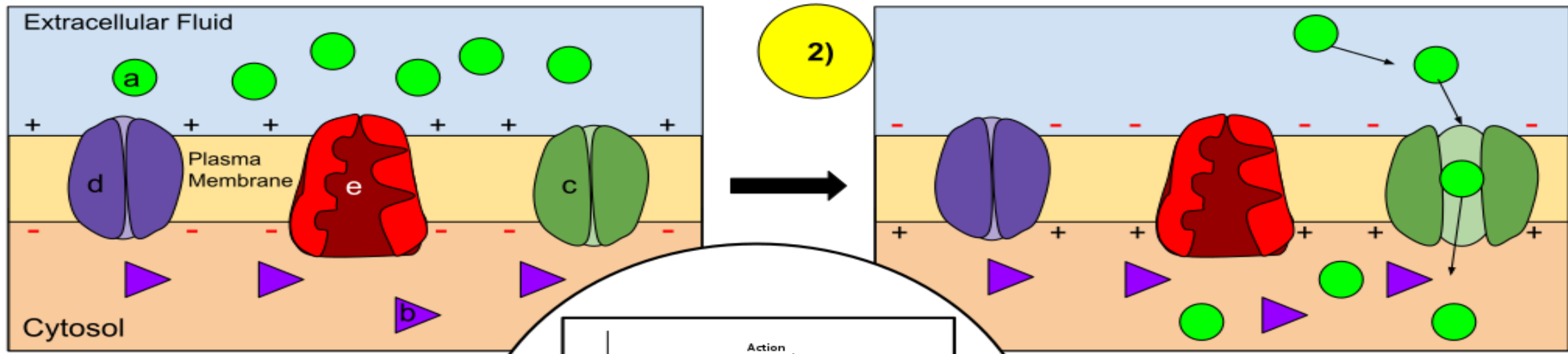
Action potential

A neuron can receive input from other neurons and, if this input is strong enough, send the signal to downstream neurons.

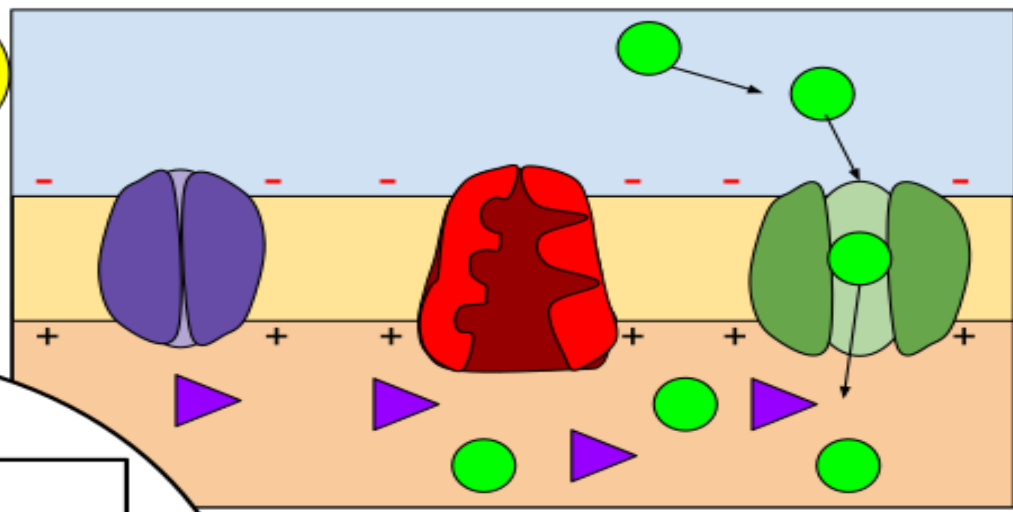
Transmission of a signal **between neurons** is generally carried by a chemical called a **neurotransmitter**.

Transmission of a signal **within a neuron** (from dendrite to axon terminal) is carried by reversal of the resting membrane potential called an **action potential**.

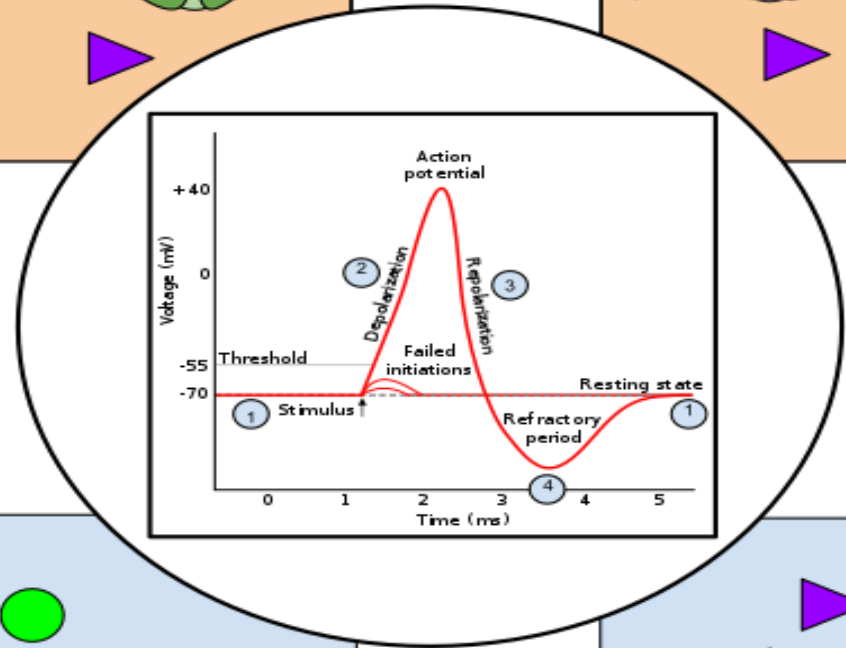
An **action potential** is defined as a sudden, fast, transitory, and propagating change of the resting membrane potential. Only **neurons and muscle** cells are capable of generating an action potential; that property is called the **excitability**



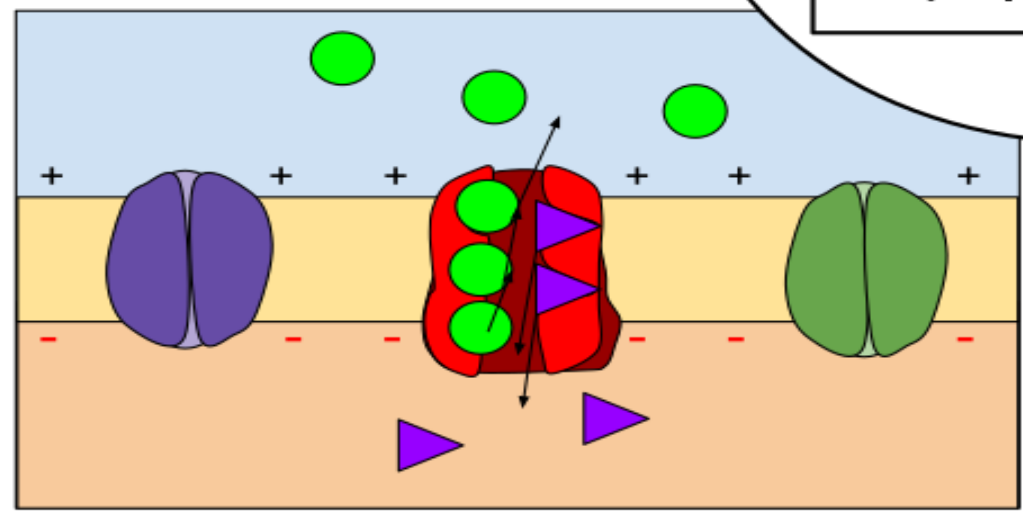
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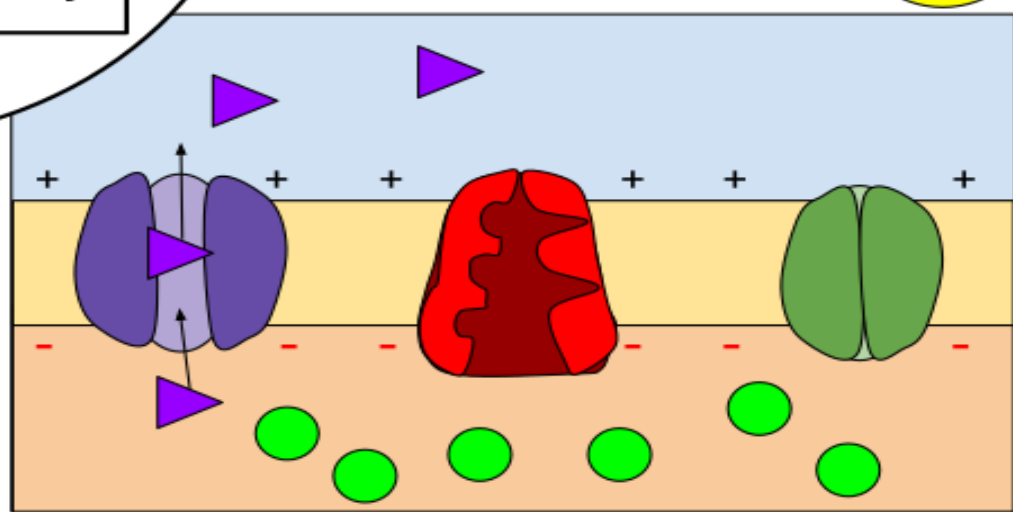
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THANK YOU!

