

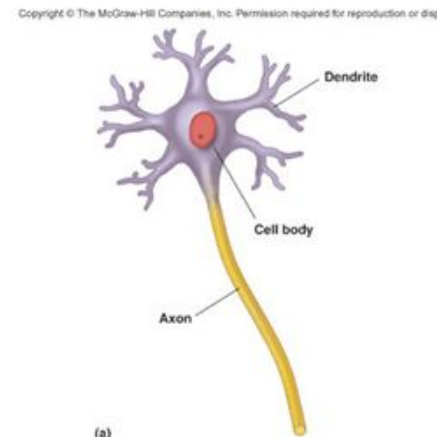
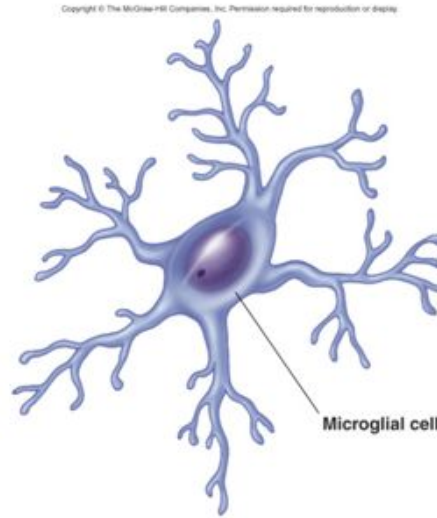
Unit 5

NERVOUS SYSTEM, IMMUNE SYSTEM AND CELL SIGNALLING

NERVOUS SYSTEM

CELLS OF THE NERVOUS SYSTEM

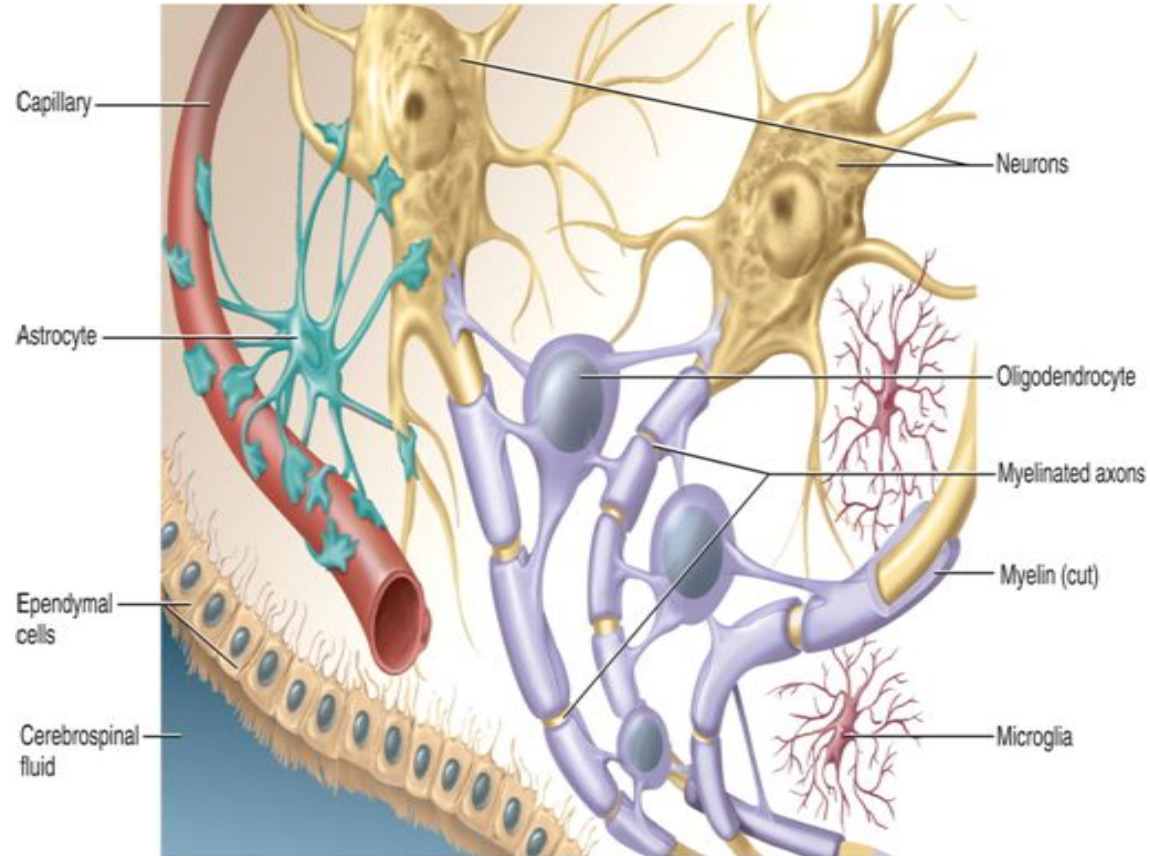
- The complex nature of the brain and associated nervous system allow the human beings to perform activities superior to other animals.
- The highly sophisticated neural machine, the brain, accomplishes this task by using nerve cells and the connections between them.
- The nervous system has two classes of cell: glial cells and nerve cells.



- **Glial cells** or neuroglia
 - Support and protect neurons
- **Neurons** or nerve cells receive stimuli and transmit action potentials
 - Organization
 - **Cell body** or soma
 - **Dendrites**: input
 - **Axons**: output

1. SUPPORTING CELLS :GLIAL CELLS

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The supporting cells

- Provide a supportive scaffolding for neurons
- Segregate and insulate neurons
- Guide young neurons to the proper connections
- Promote health and growth

TYPES OF GLIAL CELLS

Six Types of Neuroglial Cells

- **Oligodendrocytes** form **myelin sheaths in CNS**
 - each wraps processes around many nerve fibers
- **Astrocytes**
 - contribute to BBB & regulate composition of brain tissue fluid
 - most abundant glial cells - form framework of CNS
 - sclerosis – damaged neurons replace by hardened mass of astrocytes
- **Ependymal cells** line cavities & produce CSF
- **Microglia** (macrophages) formed from monocytes
 - concentrate in areas of infection, trauma or stroke
- **Schwann cells** **myelinate fibers of PNS**
- **Satellite** cells with uncertain function

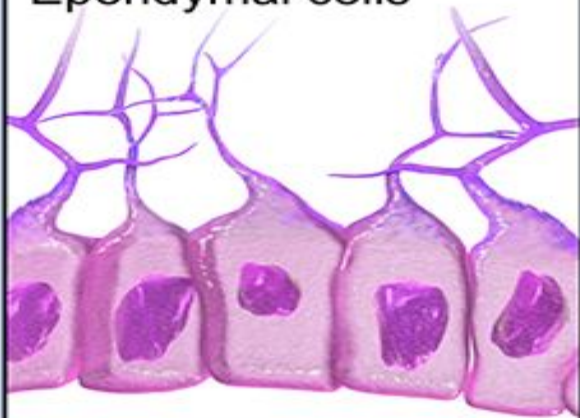
Glial Cell Types by Location and Basic Function

CNS glia	Basic function
Astrocyte	Support
Oligodendrocyte	Insulation, myelination
Microglia	Immune surveillance and phagocytosis
Ependymal cell	Creating CSF

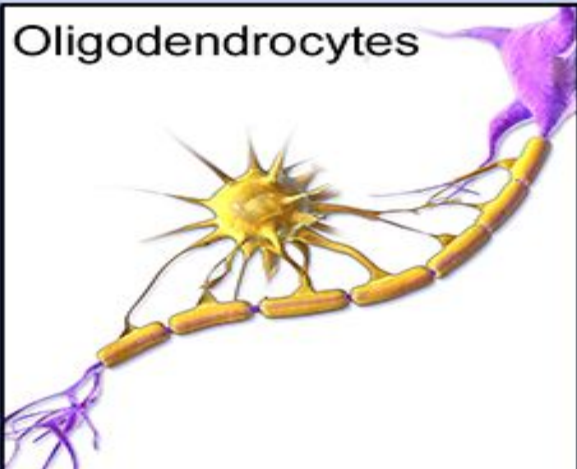
Types of Neuroglia

Central Nervous System

Ependymal cells



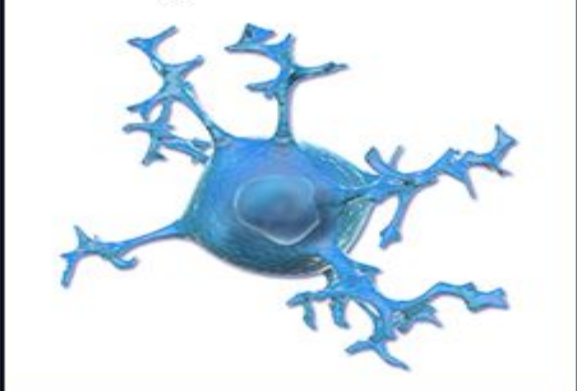
Oligodendrocytes



Astrocytes



Microglia

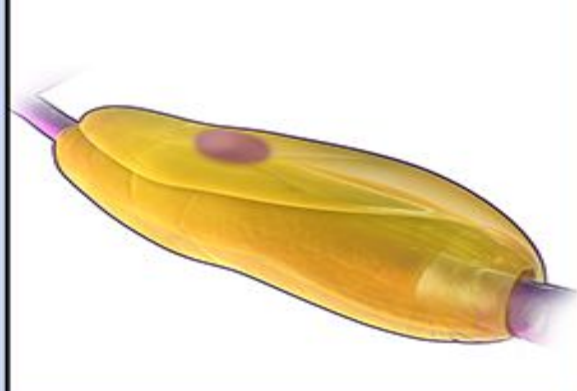


Peripheral Nervous System

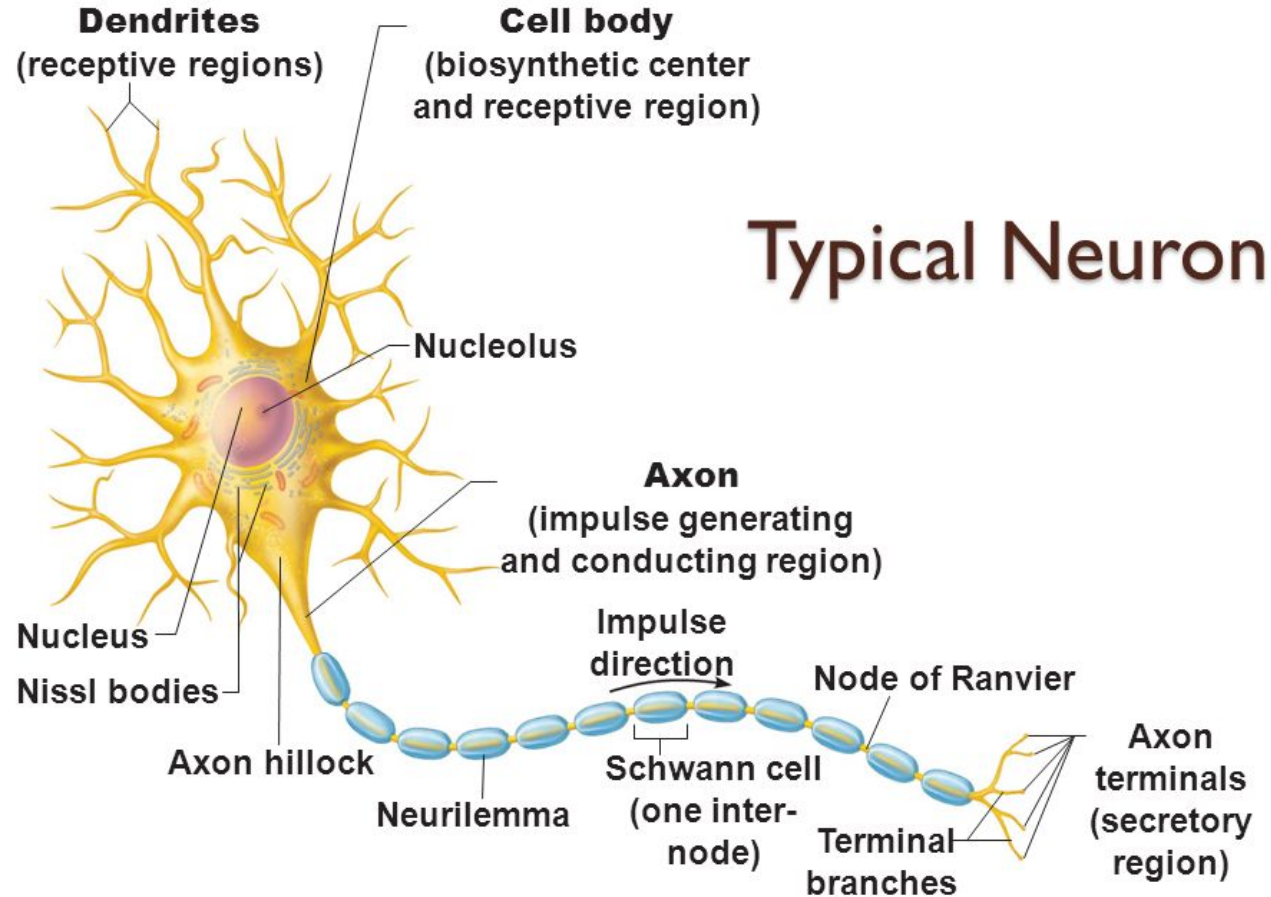
Satellite cells



Schwann cells



2. NERVE CELLS



Nodes of Ranvier

- are bare spots where myelin is not present
- allows impulse to “**jump**” from one node to the next & further *increase* speed of transmission

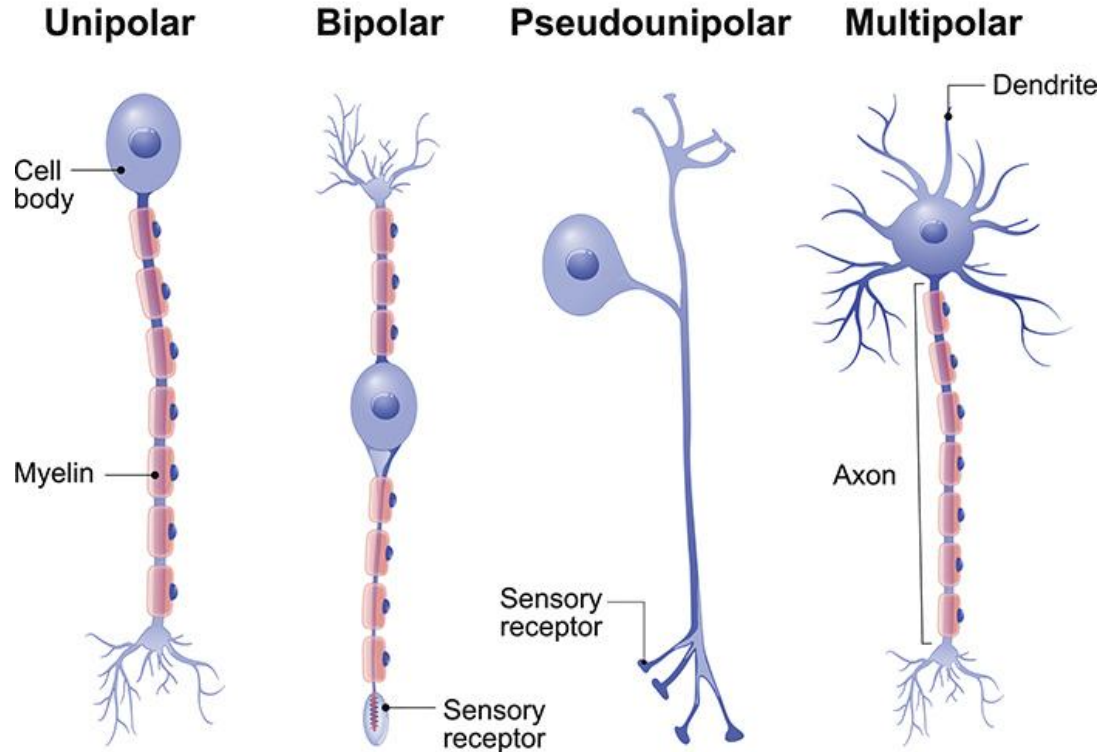
- The Nissl substance is responsible for synthesizing protein, which flows along the dendrites and the axon and replaces the proteins that are broken down during cellular activity.

AXON HILLOCK is the area on the soma where the action potential of the neuron builds up before it transmits the signal down the axon.

Schwann cells

- Form myelin sheath in the peripheral nervous

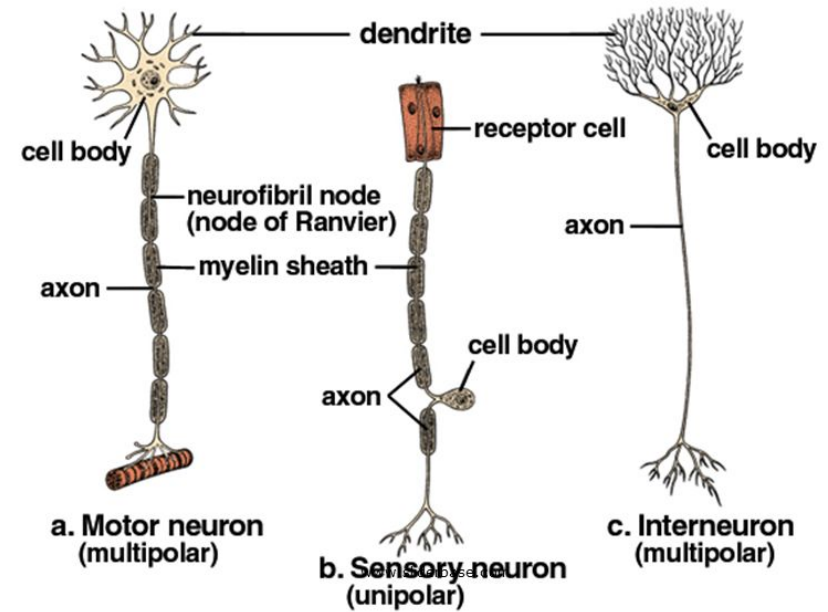
TYPES OF NERVE CELLS



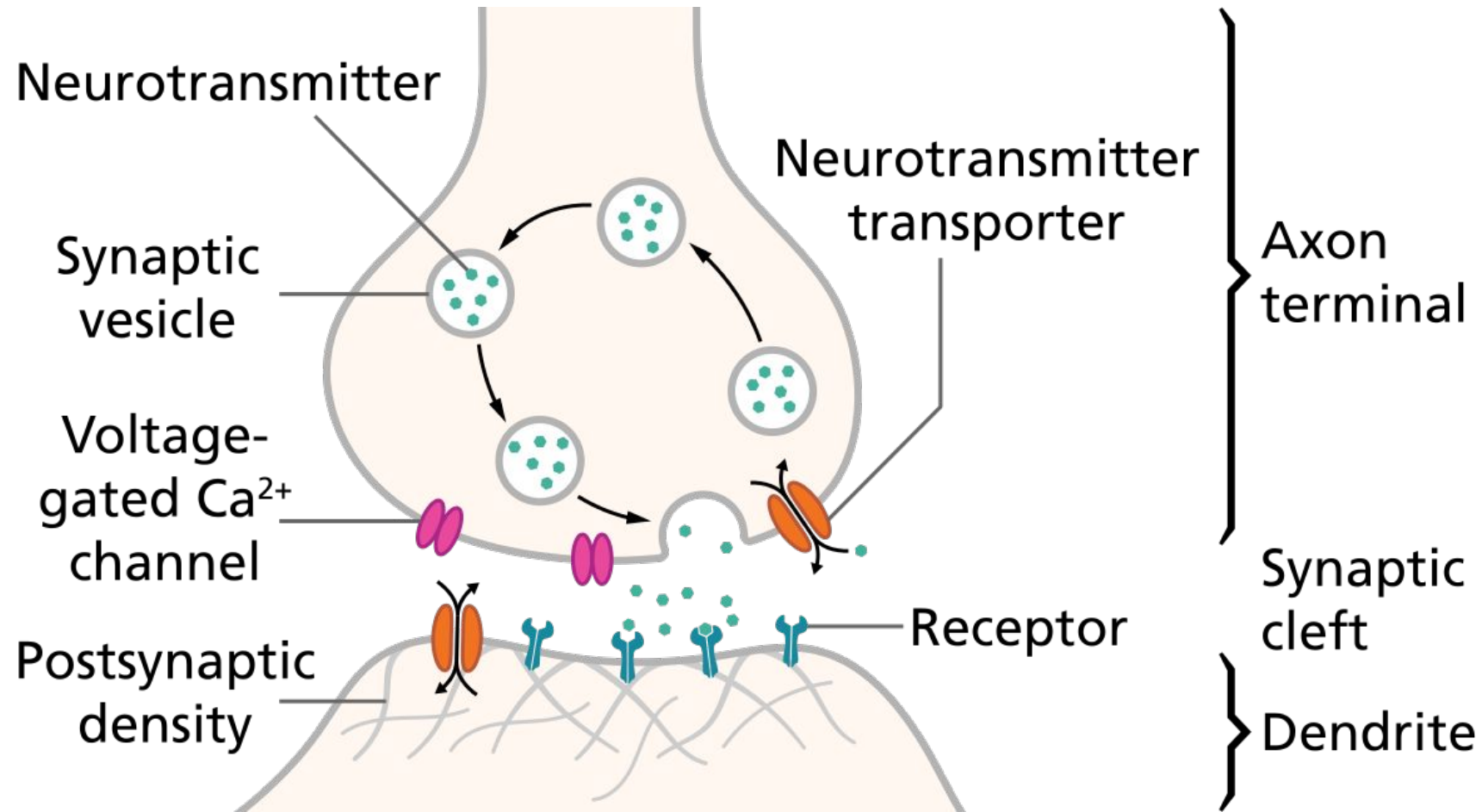
Types of Neurons

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Neuron anatomy

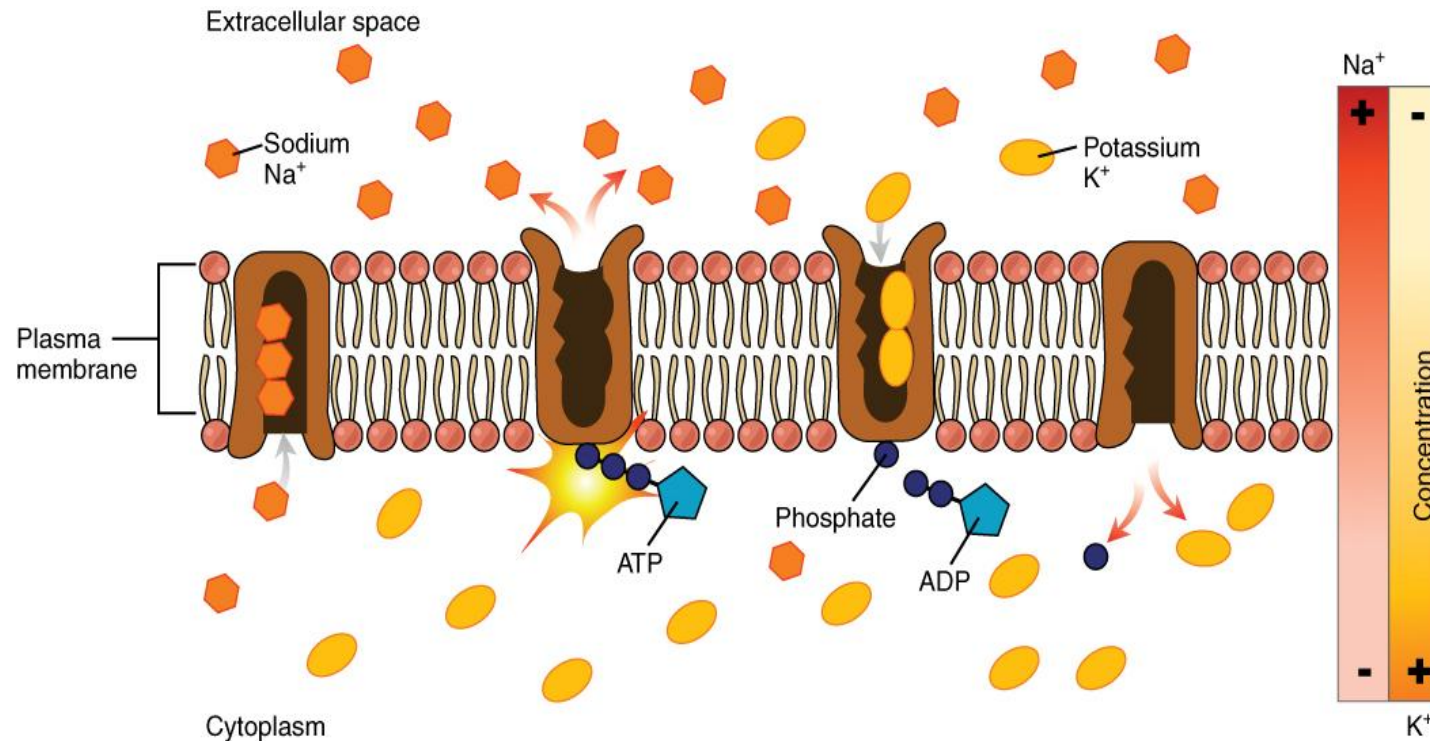


SYNAPSE

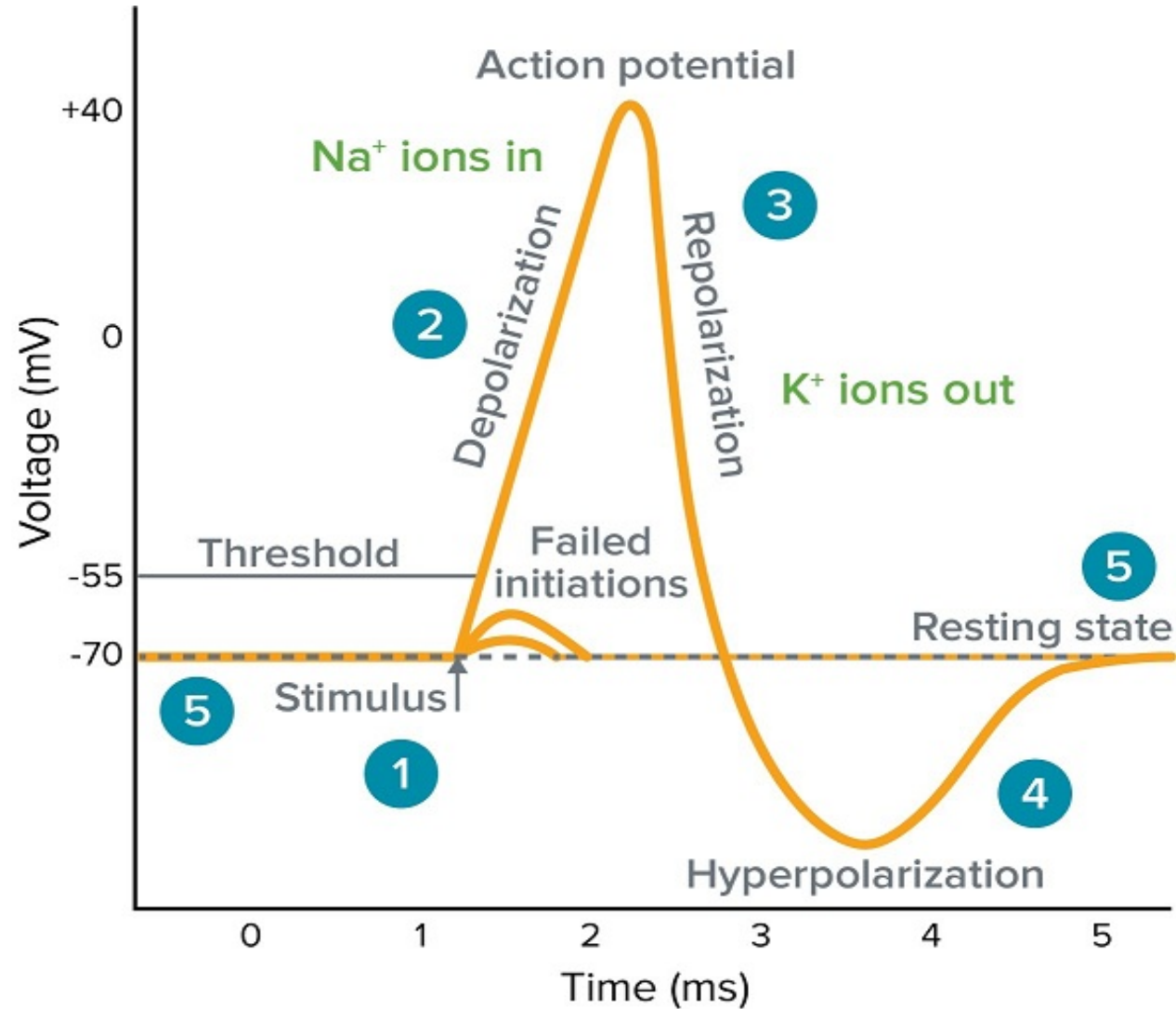


ACTION POTENTIAL

- The unique feature of the neurons to generate an electrical current in response to excitation is called action potential.
- After entry of sodium ion from outside, they travel to axon hillock where the summation of all electrical currents occur.
- Neural signals which are excitatory open Na^+ channels while others which are inhibitory open Cl^- and K^+ channels
- Depending on the strength of the signals, the axon hillock decides whether to propagate or not propagate the action potential.

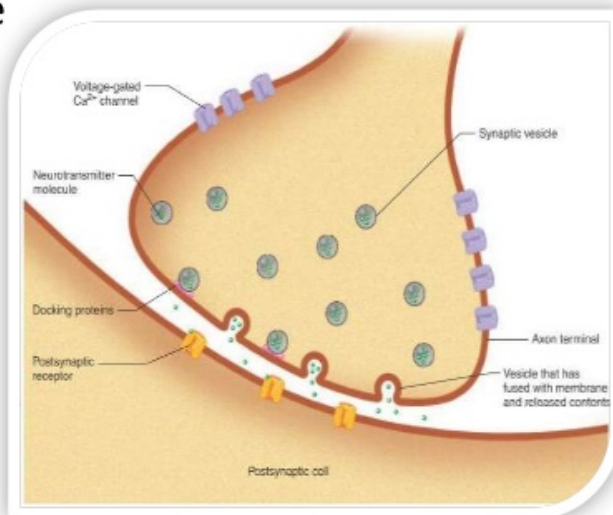


ACTION POTENTIAL



NEUROTRANSMITTERS

Neurotransmitters are the **chemical** substances which are **responsible** for **transmission** of an **impulse** through a synapse.



Schematic diagram of synapse

NEUROTRANSMITTERS

ADRENALINE

fight or flight

produced in stressful situations. Increases heart rate and blood flow, leading to physical boost and heightened awareness.

GABA

calming

Calms firing nerves in the central nervous system. High levels improve focus, low levels cause anxiety. Also contributes to motor control and vision.

NORADRENALINE

concentration

affects attention and responding actions in the brain. Contracts blood vessels, increasing blood flow.

ACETYLCHOLINE

learning

Involved in thought, learning and memory. Activates muscle action in the body. Also associated with attention and awakening.

DOPAMINE

pleasure

feelings of pleasure, also addiction, movement and motivation. People repeat behaviors that lead to dopamine release.

GLUTAMATE

memory

Most common neurotransmitter. Involved in learning and memory, regulates development and creation of nerve contacts.

SEROTONIN

mood

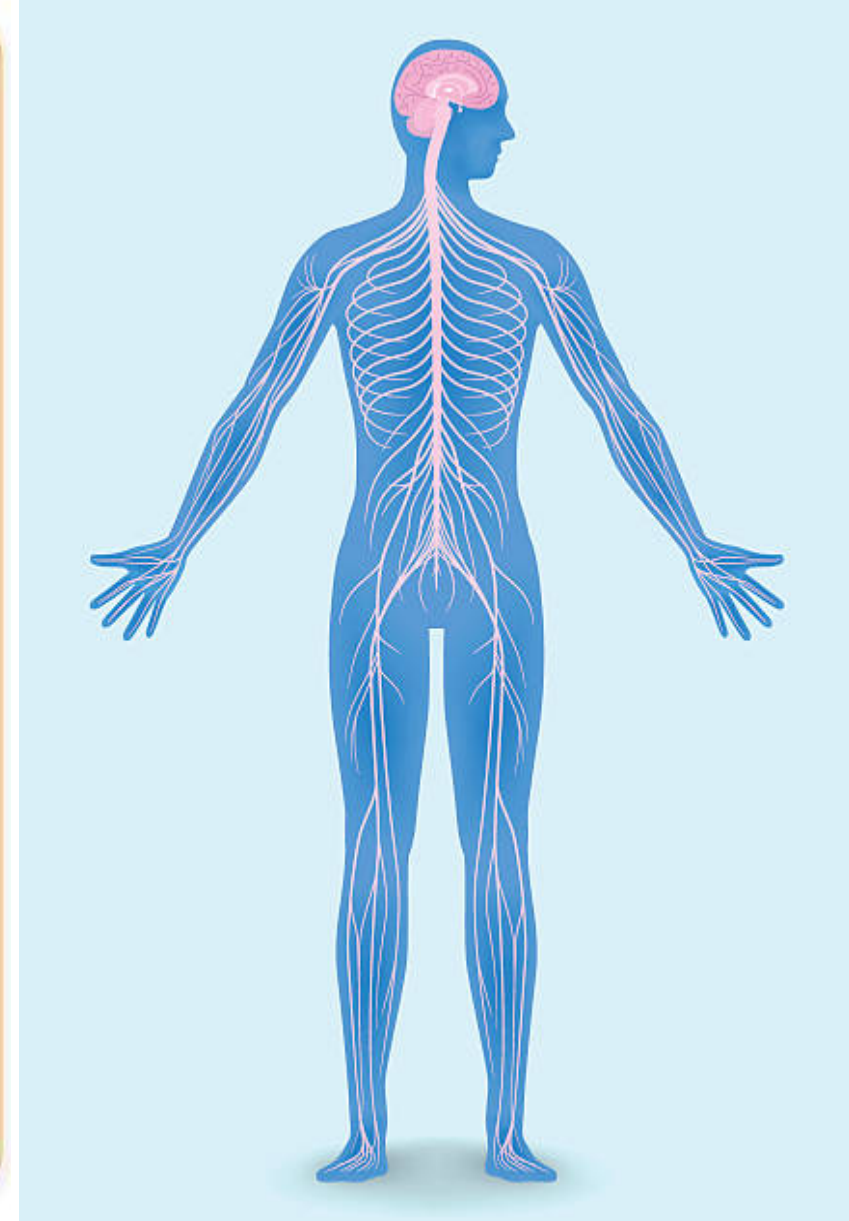
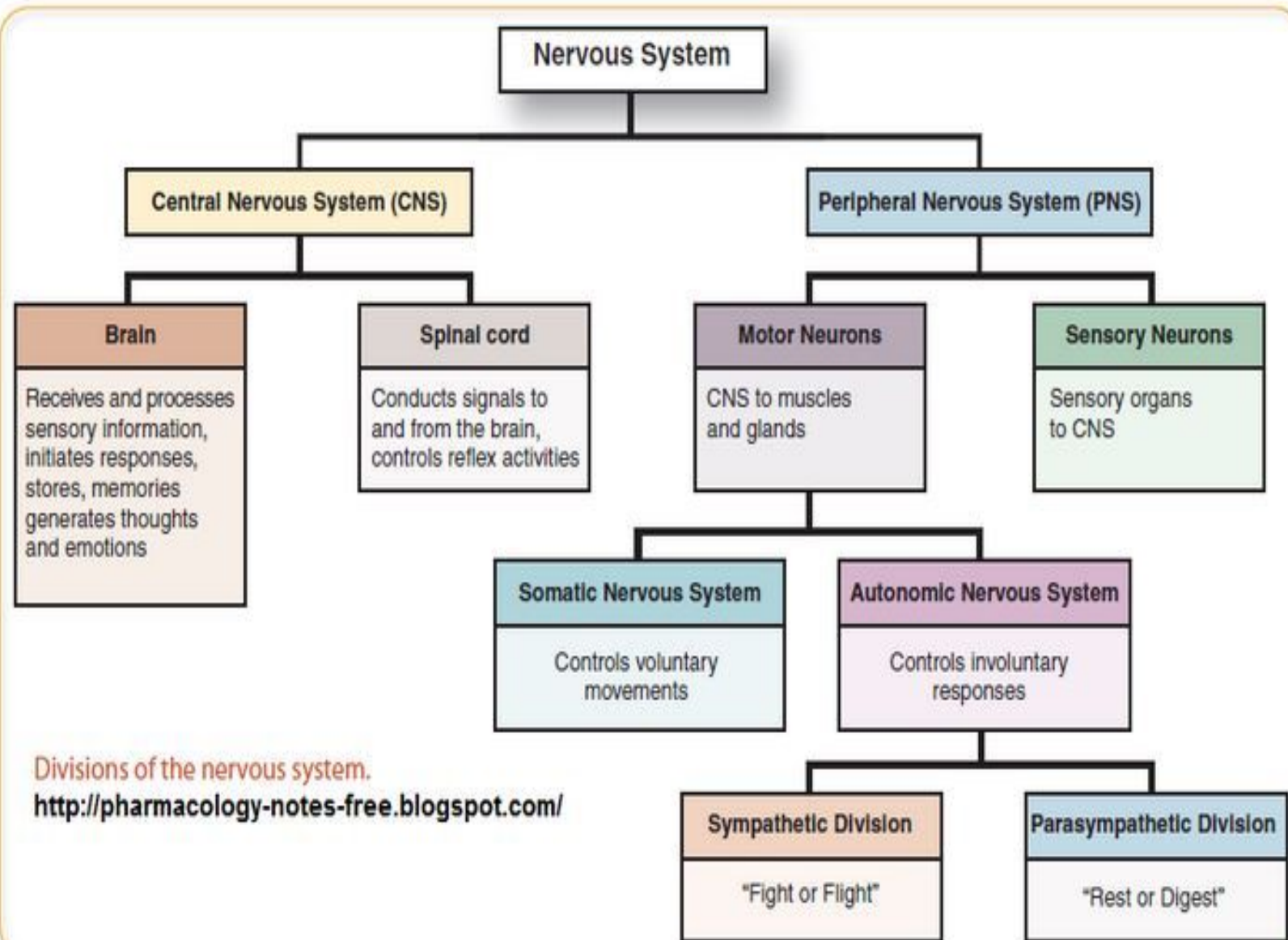
contributes to well-being and happiness. Helps sleep cycle and digestive system regulation. Affected by exercise and light exposure.

ENDORPHINS

euphoria

Released during exercise, excitement and sex, producing well-being and euphoria, reducing pain

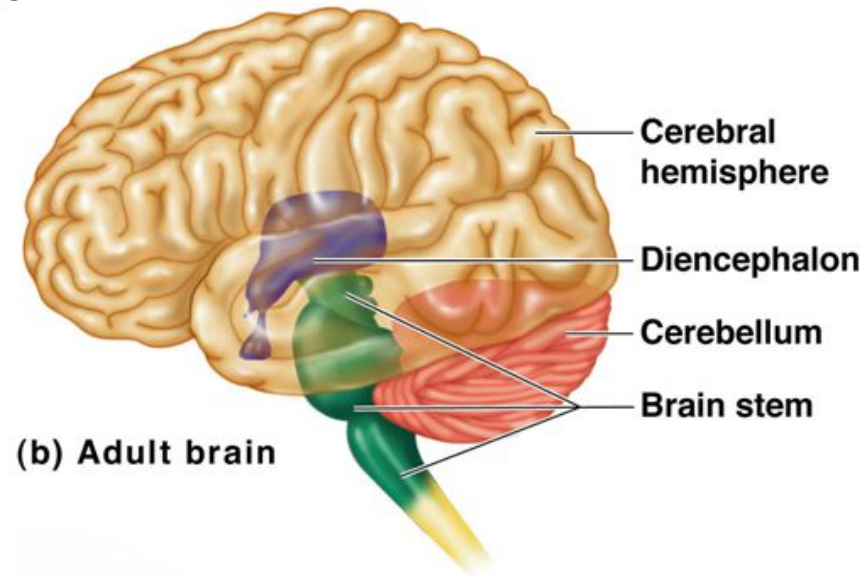
ORGANIZATION OF NERVOUS SYSTEM



CENTRAL NERVOUS SYSTEM

Regions of the Brain

1. Cerebral hemispheres (cerebrum)
2. Diencephalon
3. Brain stem
4. Cerebellum

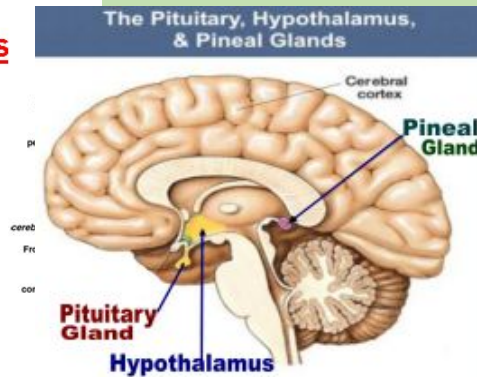


CENTRAL NERVOUS SYSTEM

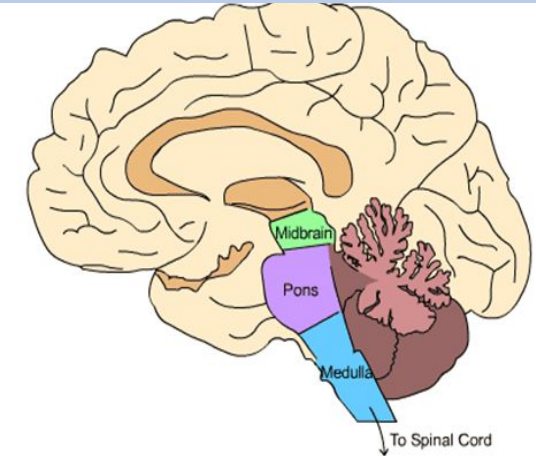
- Largest part of the brain (specifically the forebrain)
- Cerebral cortex is thrown into folds (gyri) and fissures (sulci).
- Cerebral cortex divided into lobes i.e temporal, frontal, parietal and occipital by these grooves .
- Control functions like thinking speech, emotions, vision, pain, hearing etc.

Diencephalon has two parts: Thalamus and Hypothalamus

- Thalamus
 - **Relays** and **processes** sensory information
- Hypothalamus
 - Hormone production
 - Emotion
 - Autonomic function
- Pituitary gland
 - Major endocrine gland
 - Connected to hypothalamus
 - Via **infundibulum** (stalk)
 - Interfaces nervous and endocrine systems

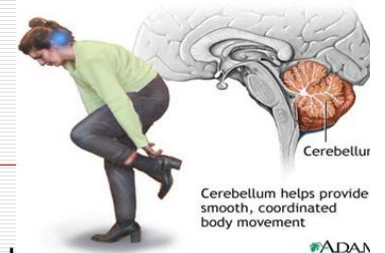


- Pons
 - Relay station for cortex
- Medulla oblongata
 - Controls vital functions
 - Heart rate
 - Breathing
 - Blood pressure
 - Swallowing
 - vomiting

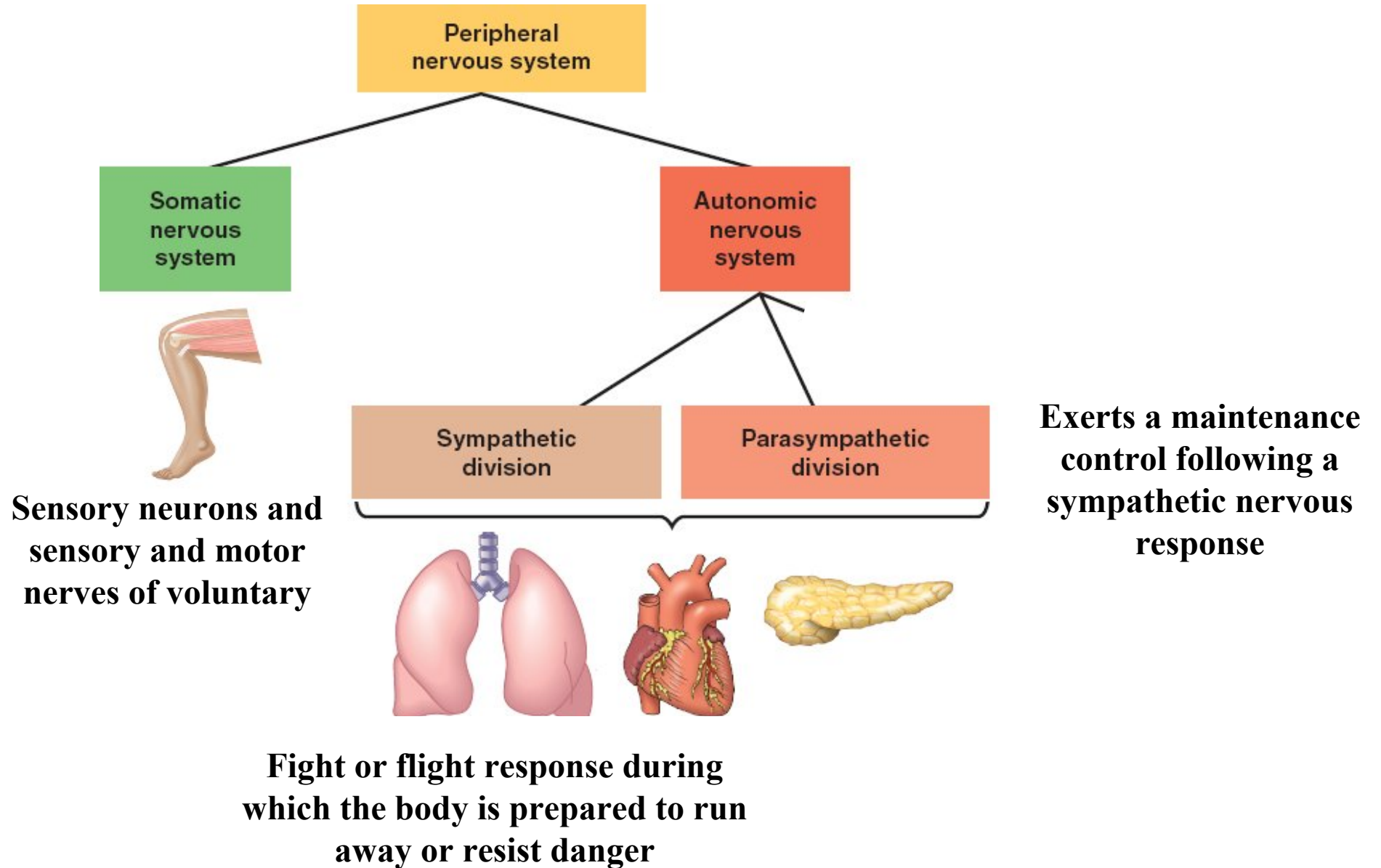


Cerebellum

- Functions
 - Coordination of voluntary muscles
 - Maintenance of balance
 - Maintenance of muscle tone
- Effects of alcohol
 - Cerebellum function is temporarily affected by alcohol and other drugs.
 - Field sobriety tests are test of cerebellar function
 - Cerebellum function may be permanently affected by long term alcoholism, stroke or trauma



PERIPHERAL NERVOUS SYSTEM



DISEASES OF THE NERVOUS SYSTEM

1. Dementia is another disorder associated with aging seen in patients over 60.

Dementia Symptoms



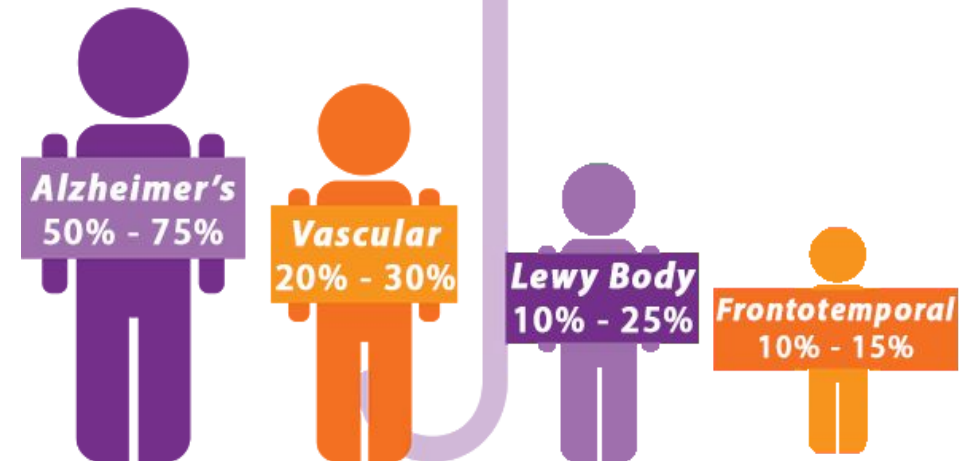
DRIVING: **MEDICATIONS:** **COOKING:** **FALLS:** **WANDERING:**

- Memory Loss
- Language and communication problems
- General Confusion, disorientation in time and/or place
- Difficulty with abstract thinking/ lapses in judgement
- Misplacing objects
- Behavior and personality familiar activities
- Loss of initiative/apathy



DEMENTIA

An umbrella term describing a set of symptoms causing a person to have changes in brain function that interfere with the ability to function and do everyday activities



Most common type of dementia observed in Western countries is Alzheimer's disease.

Symptoms of Alzheimer's Disease

Memory loss



Challenges in Planning or Solving Problems

Gradual loss of ability to perform normal tasks



Confusing day from night

Loss of vision and coordination

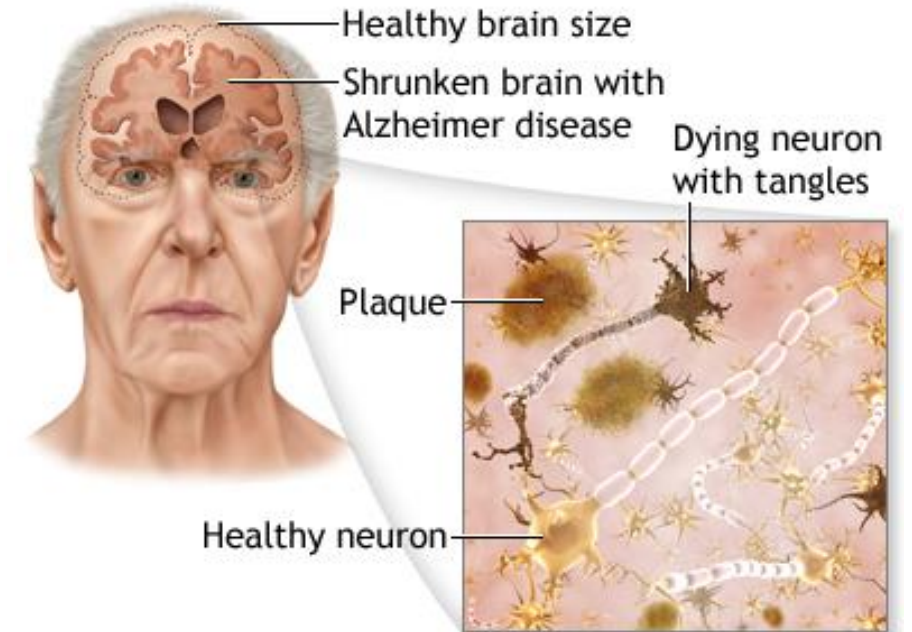


Inappropriate use of words

Inability to recognize and use familiar objects



Mood changes

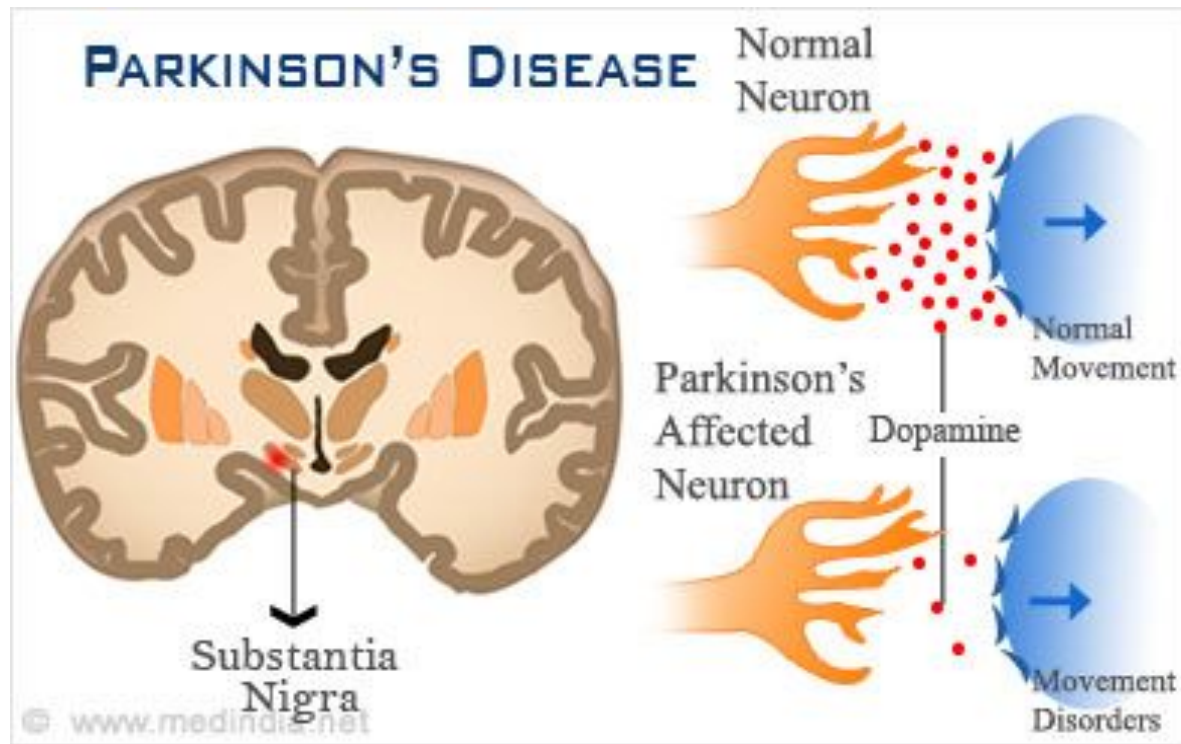


ADAM.

- **Loss of neurons in the cortex, hippocampus regions.**
- **Deposition of amyloid plaques containing beta amyloid protein.**

2. Parkinson disease

- Parkinson is usually observed between the ages of 50-60.
- Environmental toxins may be responsible for onset of the disease.
- Destruction of cell bodies and neurons that produce dopamine.



Parkinson's Disease Symptoms



- Memory Loss, Dementia
- Anxiety, Depression
- Hallucinations



- Slow Blinking
- No Facial Expression
- Drooling
- Difficulty Swallowing



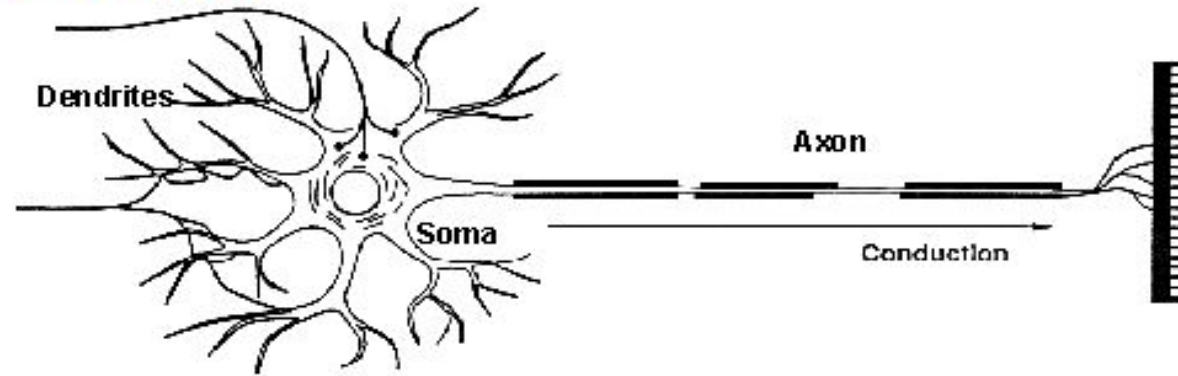
- Shaking, Tremors
- Loss of Small or Fine Hand Movements



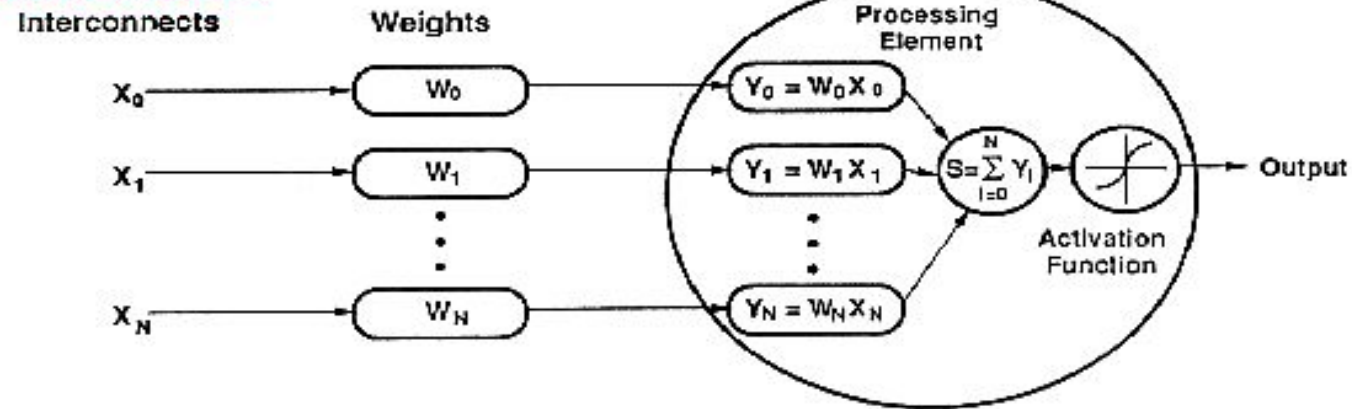
- Problem with Balance or Walking
- Stooped Posture
- Aches and Pains
- Constipation

Artificial Neural Network

Biological Neuron



Artificial Neuron

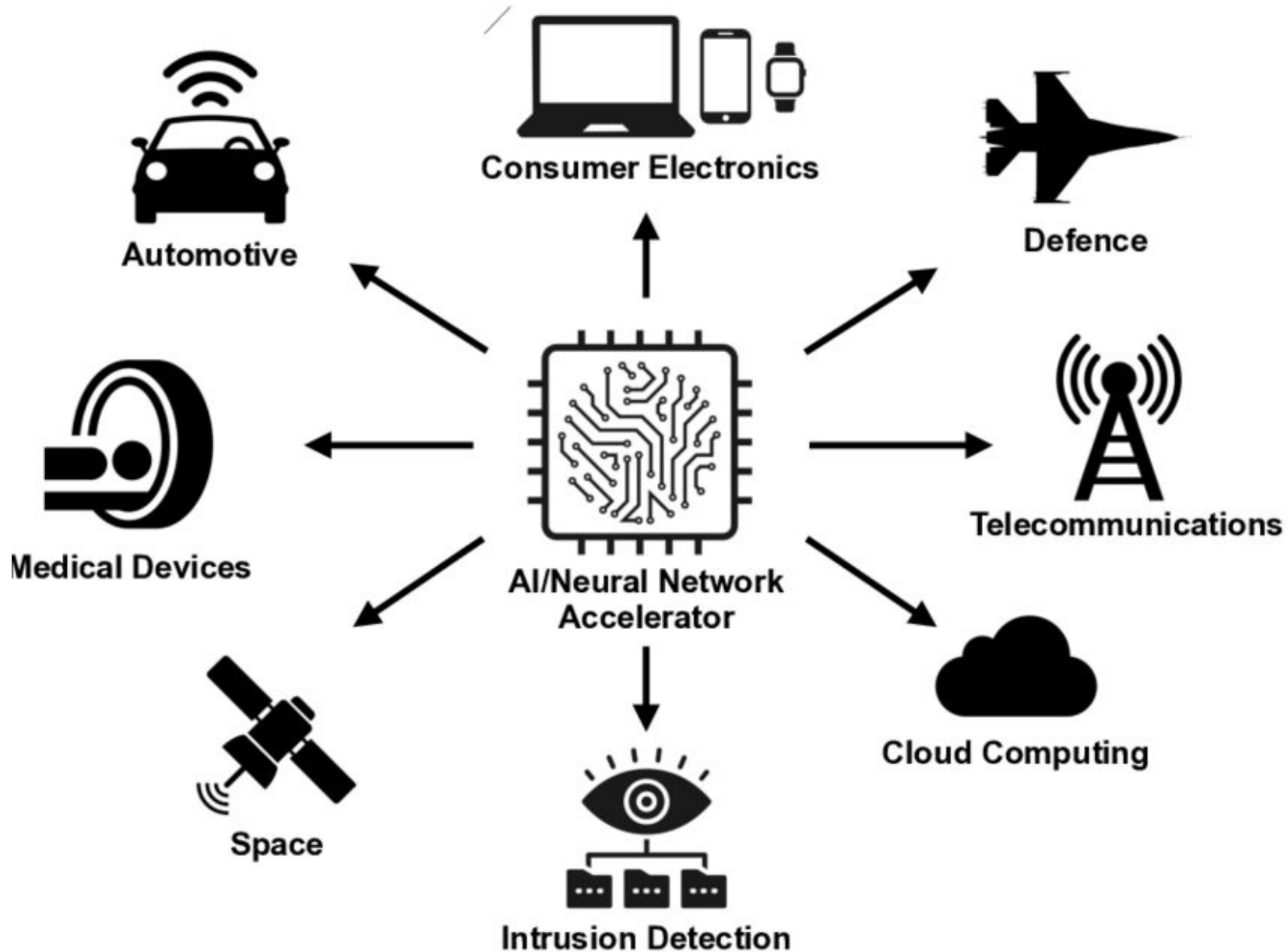


An artificial neuron is an imitation of a human neuron

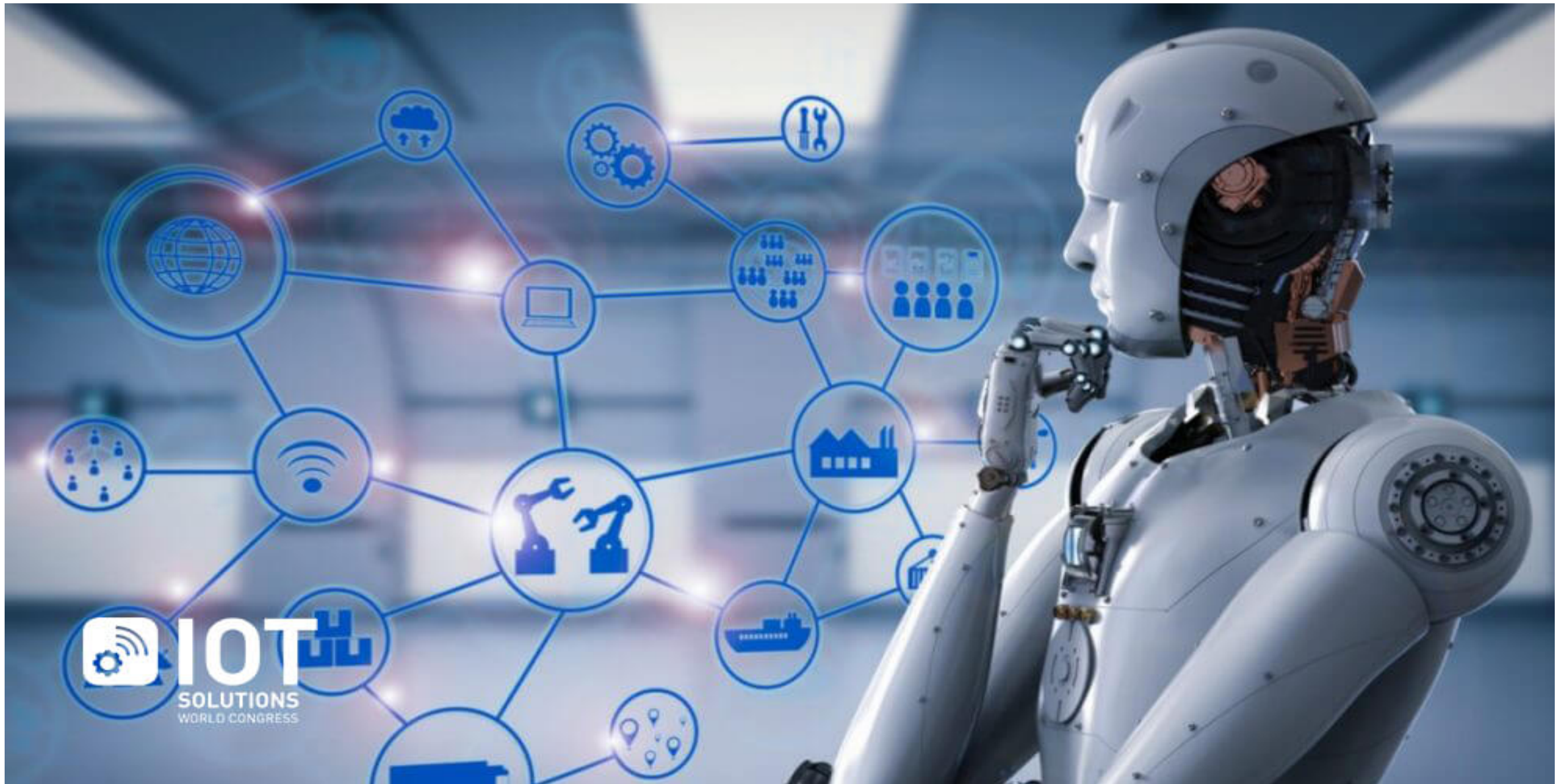
COMPUTER BASED NEURAL NETWORKS

- **Brain has certain remarkable qualities which makes it at par with any computers like**
 1. **Its performance tends to degrade gracefully under partial damage and partial recovery from damage is possible.**
 2. **It performs massively parallel computations extremely efficiently.**
 3. **It supports our intelligence and self awareness through yet to be determined mechanism.**
- **Neural Networks attempt to bring computers a little closer to the brains' capabilities by imitating certain aspects of the brain in a simplified way.**
- **Neural networks are not biological rather only elements of a program or silicon circuits.**
- **Although these networks are not as powerful as human brain, they can be trained to perform useful functions.**
- **Two concepts were responsible for emergence of neural networks (i) Statistical mechanics (ii) back propagation algorithm.**
- **Neural networks have been applied to different applications like aerospace, automotive, banking, defence, electronics, mathematics etc.**

COMPUTER BASED NEURAL NETWORKS



THANK YOU



PRACTICE THESE DIAGRAMS

