The process of homeostasis makes sure that the activities that occur in the body are maintained within normal physiological limits. In addition, our body constantly reacts to a multitude of signals, be it external or internal signals.

Two body systems are responsible for dealing with these signals and controlling the state of homeostasis:

- Endocrine system: releases hormones into the blood stream, with a slow action response

- Nervous system: communicates by means of electrical signals, resulting in an immediate response
Nervous System

The nervous system has 3 overlapping functions:

**Sensory** : uses sensory receptors to detect internal and external changes (stimuli)

**Integrative** : analyzes the sensory information, stores it and makes decision

**Motor** : responds to stimuli by initiating muscular contractions or glandular secretions

The branch of **Neurology** is the study of the normal and disordered nervous system

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Organization of the Nervous System

**The Central Nervous system (CNS)**

- consists out of the Brain and Spinal Cord (integrating and command center)
- it is connected to the sensory receptors, muscles and glands in the Peripheral Nervous system

**The Peripheral Nervous system (PNS)**

- consists out of cranial (arise from the brain) and spinal (originate from the spinal cord) nerves
- they carry impulses in and out of the CNS
The Peripheral Nervous system

**The Sensory division**
- the input component (from sensory receptors to the CNS)
- contain the afferent nerves
  - somatic afferent part: input from skin, skeletal muscle and joints
  - visceral afferent part: input from the organs and glands

**The Motor division**
- the output component (from CNS to the muscles, glands)
- contain the efferent nerves

The Motor division

The motor division of the PNS has an additional two functional subdivisions

**The Somatic (motor)Nervous system**
- also called the voluntary nervous system
- composed of somatic motor nerve fibers that conduct impulses from CNS to skeletal muscles

**The Autonomic Nervous System**
- also called involuntary nervous system
- consist of visceral motor nerve fibers that regulate the activities of smooth muscles, cardiac muscles and glands
The Autonomic Nervous System

- **Sympathetic**: usually involves expenditure of body energy, stimulates
- **Parasympathetic**: restores and conserves body energy, inhibits

Nervous system

- Central NS
- Peripheral NS
- Sensory Division
  - Somatic Division
  - Visceral Division
- Motor Division
  - Somatic Division
  - Autonomic Division
    - Sympathetic
    - Parasympathetic
Nervous system

Histology of the Nervous System

Nervous tissue is made up of two principle types of cells

• Neurons: the excitable nerve cells that conduct the electrical signals

• Supporting cells: support, nurture and protect the neurons (also called Neuroglial cells)
Neuron Anatomy

Axons: undergo action potentials to deliver information, typically neurotransmitters, from the axon terminals.

Dendrites: receive information (the neurotransmitters)
Neuronal Synapse

Synapse: a special site where two neurons communicate.

NEURONAL COMMUNICATION

Presynaptic membranes "deliver information" in the form of neurotransmitters.

Postsynaptic membranes "receive information" because they have receptors for neurotransmitters.
Axonal Transport

Communication between cells and along an axon is in the form of electrical signals.

However, an axon also transports molecules up and down the long pathway in order to deliver material to and from the axon terminals (called anterograde and retrograde transport).

Axon terminal has for example no Nissl bodies; thus no means to produce proteins!

Retrograde transport is fast and uses ATP-fueled motor molecules called Kinesin that “walk” along microtubules and transport particles.
Structural Classification of Neurons

Neurons come in different forms

(a) Anaxonic neuron
(b) Bipolar neuron
(c) Unipolar neuron
(d) Multipolar neuron
Sensory neurons
- deliver information from exteroceptors, interoceptors, or proprioceptors
- Somatic sensory neurons versus somatic visceral neurons

Motor neurons
- Form the efferent division of the PNS
- Somatic motor neurons versus Visceral motor neurons

Interneurons (association neurons)
- Located entirely within the CNS
- Distribute sensory input and coordinate motor output
NeuroGlial Cells in CNS

There are Four types of neuroglia in the CNS

**Ependymal Cells**

- These are specialized epithelial cells that line the ventricles of the brain and the central canal within the spinal cord.
- They are instrumental in the production of the cerebrospinal fluid and in circulating this fluid around.
### NeuroGlial Cells in CNS

#### Astrocytes
- Only found in CNS and perform a variety of functions
- Stabilize brain capillaries and blood brain barrier
- Repair / prevent injury
- Control Interstitial area by mopping up and recycling neurotransmitters, regulate Na⁺ and K⁺ ions, release chemicals that enhances communications

#### Oligodendrocytes
- Only found in CNS
- Are instrumental in forming the insulating coating around axons = **myelin sheaths**

#### Microglia
- Only found in CNS
- Very small and migrate through neural tissues
- Function like macrophages and remove debris, waste products and pathogens
**NeuroGlial Cells in CNS**

- Ependymal Cells
- Astrocytes
- Microglia
- Oligodendrocytes

**NeuroGlial Cells in PNS**

- **Schwann cells or Neurilemmocytes**
  - Only found in PNS
  - Have similar function as oligodendrocytes and form the *myelin sheaths* around axons.

- **Satellite cells or Amphicytes**
  - Only found in the ganglia of the PNS
  - Function is similar to that of astrocytes
NeuroGlial Cells in PNS

- A nerve fiber is the terminology for a single axon.
- A nerve is a bundle of nerve fibers, surrounded by connective tissue, and running within the PNS.
- Tracts are bundles of nerve fibers in the CNS.
- Ganglia are Nerve cell bodies clustered together in the PNS.
- A nucleus (nuclei) is (are) a collection of nerve cell bodies within the CNS.

Additional Definitions

- White matter refers to the aggregation of myelinated processes in the brain.
- Gray matter is the combination of nerve cell bodies, dendrites, axonal terminals or bundles of un-myelinated axons and neuroglia in the brain.

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