UNIT-IV
Peripheral Nervous System (PNS)

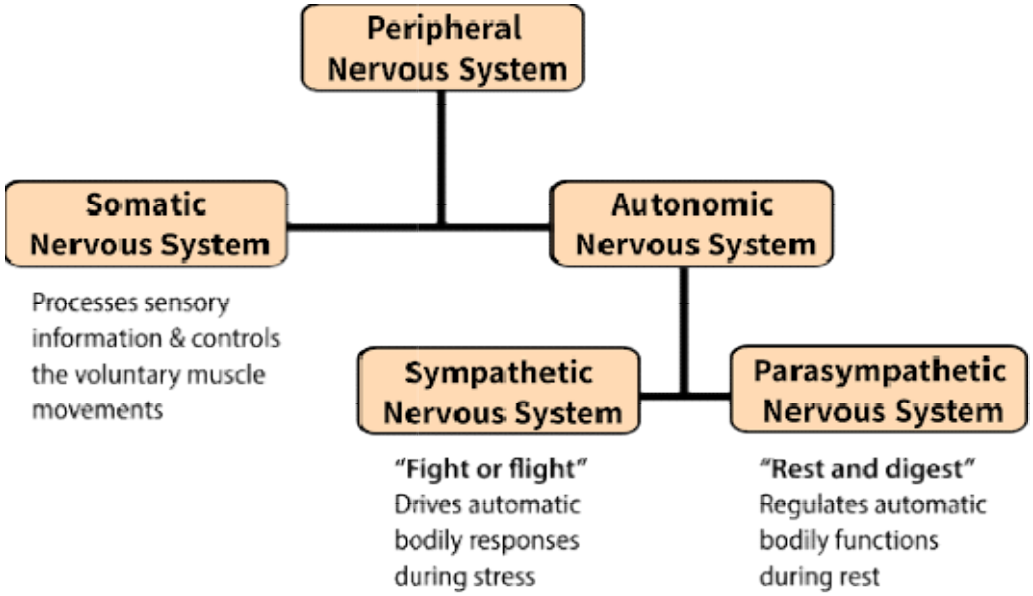
Definition

The two principle divisions of the nervous system are the **central nervous system (CNS)** and p**eripheral nervous system (PNS)**.

CNS: It consists of brain and spinal cord, integrates and correlates many different kinds of incoming sensory information.

PNS : The Peripheral Nervous System consists of all the nerves and ganglia outside the brain and spinal cord. It connects the Central Nervous System (CNS) to different parts of the body and helps in transmission of sensory and motor impulses.

Classification of Peripheral Nervous System



The PNS is divided into

1. **Somatic Nervous System**
2. **Autonomic Nervous System (ANS)**

1. Somatic Nervous System (SNS)

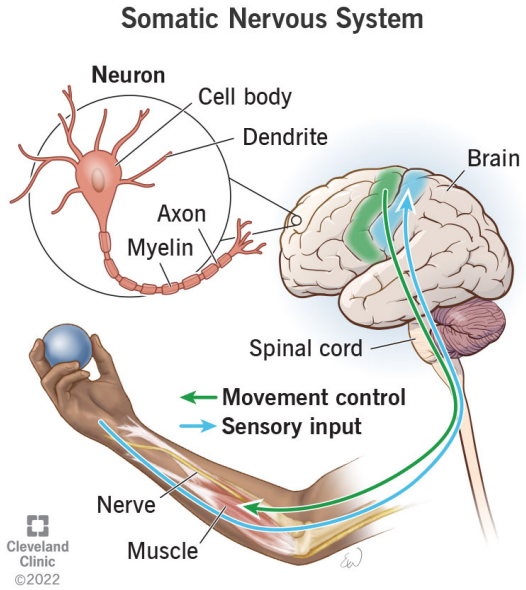
The somatic nervous system is a part of the peripheral nervous system (PNS) that controls voluntary activities of the body. It is mainly responsible for carrying sensory information to the central nervous system (CNS) and transmitting motor commands from the CNS to skeletal muscles**.**

Components

1. **Sensory (afferent) neurons**
   These neurons carry impulses from sensory receptors present in the skin, muscles, joints, and special sense organs (eyes, ears, nose, tongue) to the CNS. They transmit sensations such as touch, pain, temperature, pressure, vision, hearing, taste, and smell.
2. **Motor (efferent) neurons**
   These neurons carry impulses from the CNS to skeletal muscles, resulting in voluntary muscle contraction and movement.

Functions

- Controls voluntary movements like walking, writing, and speaking
- Transmits sensory information from the body to the CNS
- Helps in maintaining posture and balance
- Enables interaction with the external environment



Characteristics

- Voluntary in action
- Effectors are skeletal muscles
- Single motor neuron pathway from CNS to muscle
- Neurotransmitter involved is acetylcholine

2. Autonomic Nervous System (ANS)

The Autonomic Nervous System controls **involuntary activities** of internal organs like heart, lungs, glands, and smooth muscles.

Divisions of ANS

1. **Sympathetic Nervous System**
2. **Parasympathetic Nervous System**

These two divisions have both structural and functional differences. They normally work in an opposite manner. Each division has two motor neurons, autonomic ganglia, and effector organs.

Pre-ganglionic neurons: The first motor neuron which lies before the ganglion is called the pre-ganglionic neuron. The myelinated axon is called the pre-ganglionic fiber.

Post-ganglionic neurons: The second motor neuron which lies after the ganglion and terminates in the effector organ is called the post-ganglionic neuron. Its axon is called the post-ganglionic fiber

1. Sympathetic Nervous System (Thoracolumbar outflow)

1. It prepares the body to respond to stressful or emergency situations and is commonly known as the "fight or flight" system.
2. The sympathetic nervous system originates from the **thoracic and lumbar regions (T1–L2)** of the spinal cord, hence it is also called the **thoracolumbar outflow**.
3. It consists of **two neurons**
    1. **Preganglionic neuron** – short, arises from the spinal cord
    2. **Postganglionic neuron** – long, extends from the ganglion to the effector organ

- Sympathetic ganglia are located near the spinal cord in the **sympathetic chain**.

Functions

The sympathetic nervous system prepares the body for emergency actions by

a) Increasing heart rate and blood pressure
b) Dilating pupils and bronchi
c) Decreasing digestive activity
d) Increasing blood flow to skeletal muscles
e) Stimulating sweat glands
f) Increasing blood glucose levels

Neurotransmitters

- **Acetylcholine** is released at the preganglionic synapse
- **Noradrenaline (norepinephrine)** is released at the postganglionic synapse

Characteristics

- Involuntary in action
- Acts during stress, fear, anger, and exercise
- Produces widespread effects throughout the body

Parasympathetic Nervous System

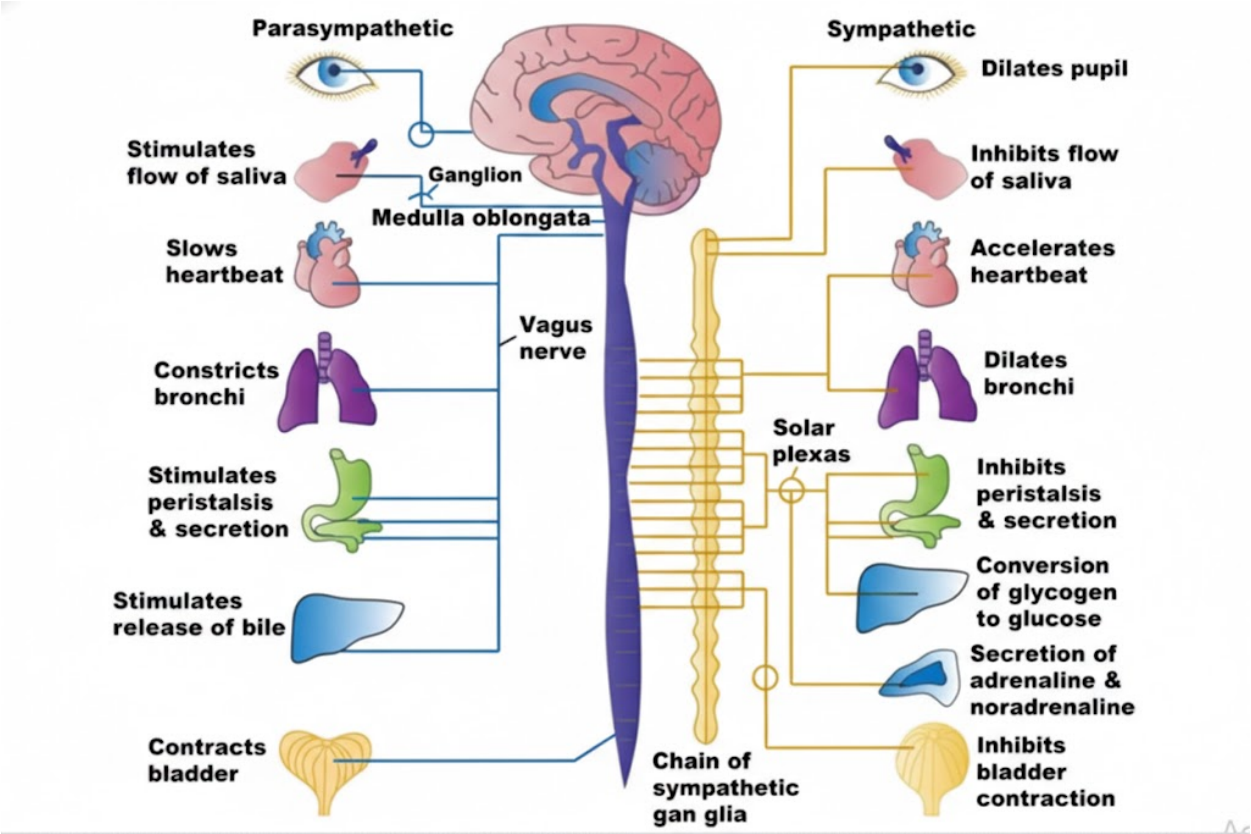
The parasympathetic nervous system (PNS) is a division of the autonomic nervous system (ANS). It controls involuntary activities of the body and is mainly responsible for conserving energy and maintaining normal body functions. It is commonly known as the "**rest and digest"** system

Structure

a) Origin: **Cranial and sacral regions**
    a. Cranial nerves: III, VII, IX, X
    b. Sacral nerves: S2–S4
b) Preganglionic neurons: **Long**
c) Postganglionic neurons: **Short**
d) Ganglia: Located **near or within target organ**
e) Neurotransmitter: Both pre and postganglionic: **Acetylcholine**

Functions

a) Decreases heart rate
b) Constricts bronchi
c) Constricts pupils
d) Increases digestive activity
e) Stimulates glandular secretions
f) Promotes urination and defecation



CRANIAL NERVES

Cranial nerves are nerves that arise directly from the **brain** (not the spinal cord). There are **12 pairs of cranial nerves**, numbered **I to XII** according to their order of origin from the brain. They supply the **head, neck**, and some internal organs.

CRANIAL NERVES					
No.	Name	Innervation	Origin	Nature	Function
I	Olfactory	Offactory Lobe of Brain	Natal chamber	Sensory	Smell
II	Optic	Diencephaton	Refina of eye	Sensory	Vision
III	Occulomotor	Eye Muscles & Ciliary Body	Cerebral Pedunde	Motor	Movement of eye ball
IV	Trochleer	Superior Oblique eye muscle	Cerebral Pedunde	Motor	Movement of eye ball
V	Trigemienl	Snout, Eye ball, Lacrymal gland, Lower eyelid, Upper lip, Upper jow, Gum, Teeth	Side of Medula	Mixed	Soniation of touch, taste, mestication, movement of lower jaw
VI	Abdusent	External rectus muscle of eye ball	Ventral side of Medula	Motor	Eye movement
VII	Facial	Taste Bud, Salivary Gland, Facial & Neck muscle	Side of Medula	Mixed	Taste, Salivation, Tear secretion
VIII	Auditory	Side of Medula	Side of Medula	Sensory	Hearing
IX	Glossopharyegeal	Pharyna, Tounge, Salivary Gland	Side of Medula	Motor	Taste, Salivation, Suallowing
X	Vagus	Pharyna, Heart, Rresoiratory tract, Pancraase, Blnod vessels, Alimentary canal	Side of Medula	Mixed	Gastlic & Pancreatic Secretion, GI movement, Cordiac reflex, Visceral refles, Respiratory reflex
XI	Spinal Astestory	Muscles of Neck & Shoulder	Side of Medula	Motor	Muscles movement & Visceral reflex
XII	Hypoclossal	Tonnge muscle	Side of Medula	Motor	Tonnge movement

SPINAL NERVES

Spinal nerves are the nerves that arise from the spinal cord. There are 31 pairs of spinal nerves, and they carry both sensory and motor fibres, therefore all spinal nerves are mixed nerves**.** They connect the spinal cord with the body trunk, limbs, and organs.

Number of Spinal Nerves

There are **31 pairs of spinal nerves**, classified according to the region of origin:

1. **Cervical nerves** – 8 pairs (C1–C8)
2. **Thoracic nerves** – 12 pairs (T1–T12)
3. **Lumbar nerves** – 5 pairs (L1–L5)
4. **Sacral nerves** – 5 pairs (S1–S5)
5. **Coccygeal nerve** – 1 pair (Co1)

Each spinal nerve is formed by the union of two roots:

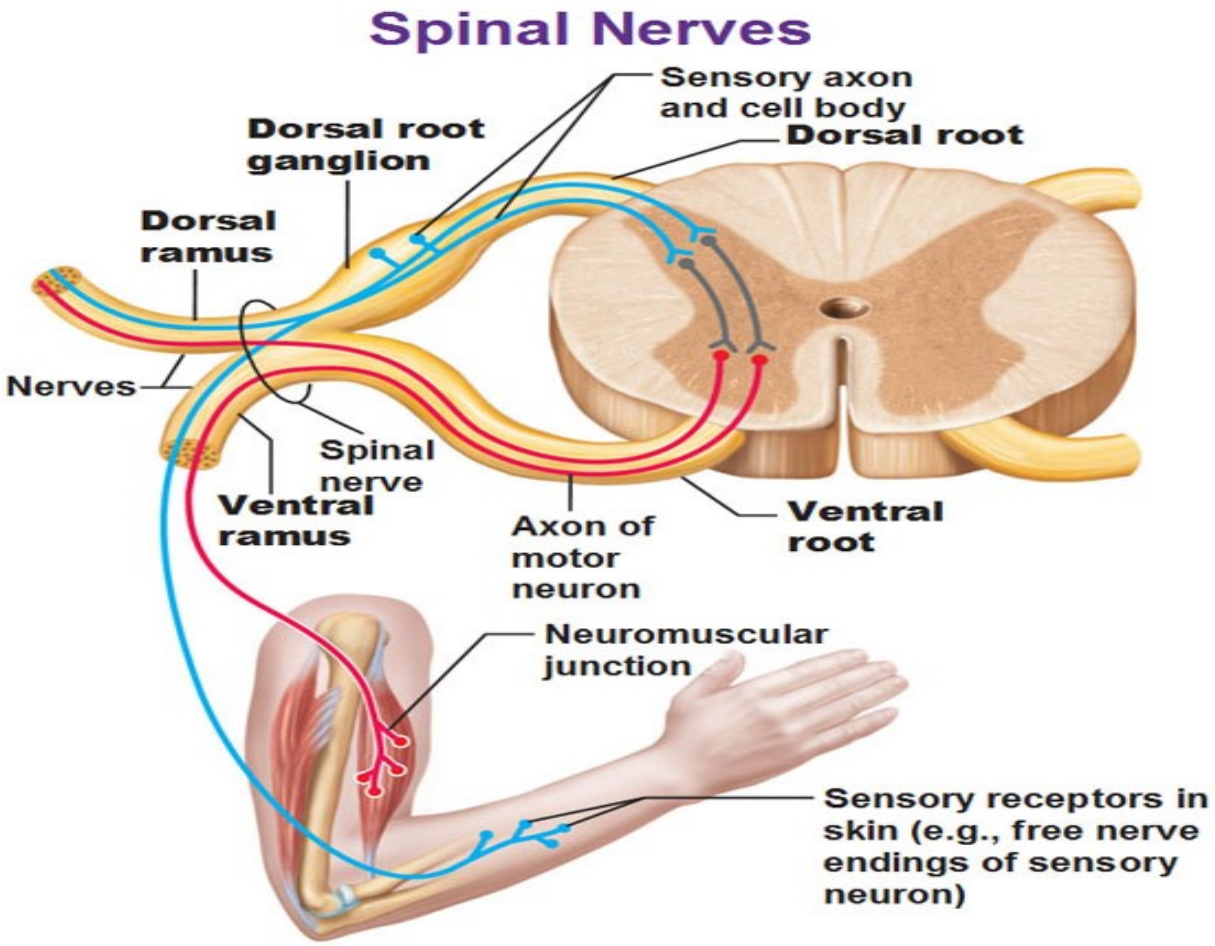
1. Dorsal (Posterior) Root

- Sensory in nature
- Carries sensory impulses from receptors to the spinal cord
- Contains a **dorsal root ganglion**, which has cell bodies of sensory neurons

2. Ventral (Anterior) Root

- Motor in nature

- Carries motor impulses from the spinal cord to muscles and glands
- Does not have a ganglion



The dorsal and ventral roots join together to form a **mixed spinal nerve**.

Branches of a Spinal Nerve

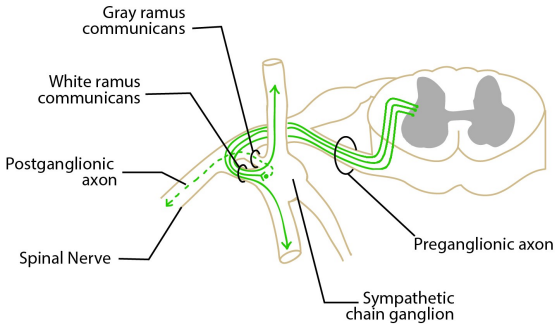
After emerging from the intervertebral foramen, each spinal nerve divides into the following branches

1. Dorsal Ramus

- Supplies muscles and skin of the **back**
- Smaller branch

2. Ventral Ramus

- Supplies the **limbs and anterior body wall**
- Larger branch
- Forms nerve plexuses (cervical, brachial, lumbar, sacral)



3. Meningeal Branch

- Supplies the **meninges**, vertebrae, and blood vessels

4. Rami Communicantes

- Connect spinal nerves to the **sympathetic chain ganglia**

- Carry autonomic nerve fibers

Functions of Spinal Nerves

a) Transmit sensory information from skin, muscles, and organs to the spinal cord
b) Transmit motor commands from the spinal cord to skeletal muscles and glands
c) Play an important role in **reflex actions**
d) Supply the trunk, limbs, and body wall

Spinal Nerve Plexuses

A plexus is a branching network of nerves. These networks act like "junction boxes," where nerve fibers from different origins are sorted and recombined to reach specific body parts.
Ventral rami of certain spinal nerves form plexuses:

a) **Cervical plexus (C1–C4)** – supplies neck and diaphragm
b) **Brachial plexus (C5–T1)** – supplies upper limb
c) **Lumbar plexus (L1–L4)** – supplies lower limb
d) **Sacral plexus (L4–S4)** – supplies pelvis and lower limb

DIFFERENCE BETWEEN SYMATHETIC AND PARASYMPATHETIC NERVOUS SYSTEM

Basis	Sympathetic Nervous System	Parasympathetic Nervous System
Division	Autonomic nervous system	Autonomic nervous system
Nature	Involuntary	Involuntary
Main role	Fight or flight	Rest and digest
Origin	Thoracolumbar (T1–L2)	Craniosacral (CN III, VII, IX, X; S2–S4)
Preganglionic fibers	Short	Long
Postganglionic fibers	Long	Short
Ganglia	Near spinal cord (sympathetic chain)	Near/within effector organs
Preganglionic transmitter	Acetylcholine	Acetylcholine
Postganglionic transmitter	Noradrenaline	Acetylcholine
Effect on heart	Increases rate	Decreases rate
Effect on pupils	Dilates	Constricts
Effect on bronchi	Dilates	Constricts
Effect on digestion	Inhibits	Stimulates
Distribution	Widespread	Limited/localized
Energy effect	Uses energy	Conserves energy