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B.Pharm – SEMESTER I

BP104T

Human Anatomy, Physiology and Pathophysiology I

UNIT IV

Peripheral Nervous System and Special Senses

ANS • Spinal & Cranial Nerves • Eye • Ear • Nose • Tongue

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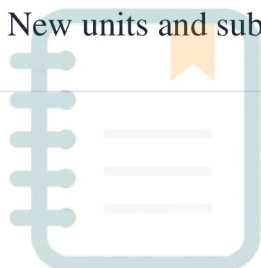
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1. Peripheral Nervous System

Classification of the Peripheral Nervous System (PNS)

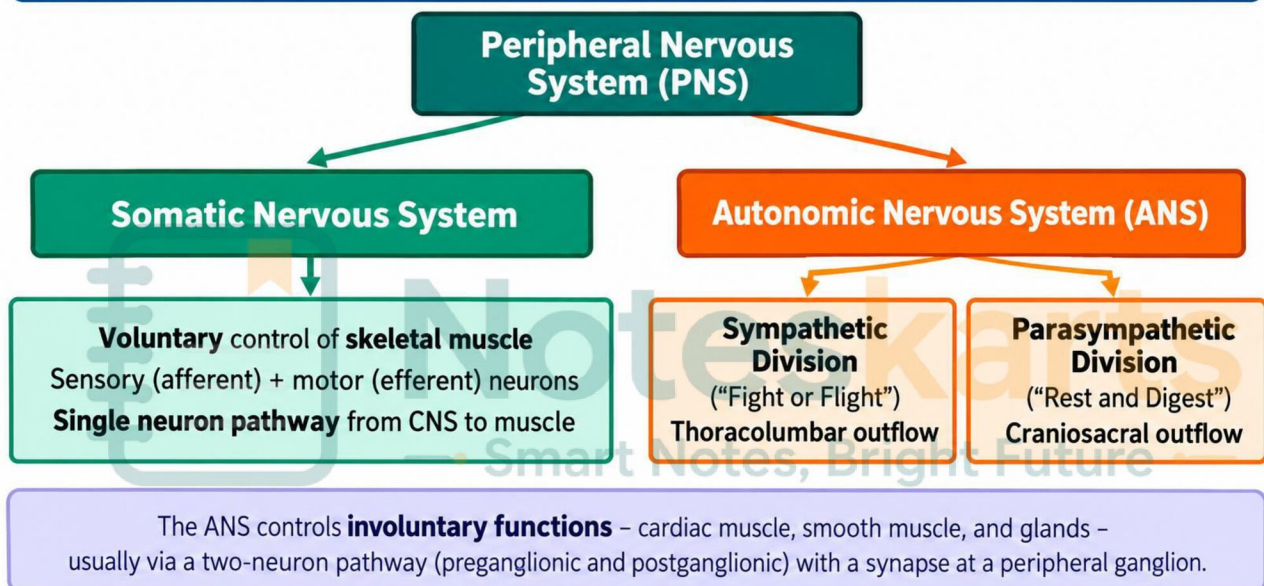


Fig. 1.1 : The PNS is divided into somatic (voluntary) and autonomic (involuntary) divisions.

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Fig. 1 – Classification of the PNS

- PNS = Somatic Nervous System (voluntary, skeletal muscle) + Autonomic Nervous System (involuntary – cardiac/smooth muscle, glands).
- ANS uses a 2-neuron pathway: preganglionic → ganglion → postganglionic → target organ.

Somatic vs Autonomic NS

- Somatic: voluntary, skeletal muscle, single-neuron pathway. Autonomic: involuntary, cardiac/smooth muscle + glands, two-neuron pathway.

Sympathetic and Parasympathetic Outflow and Target Organ Effects

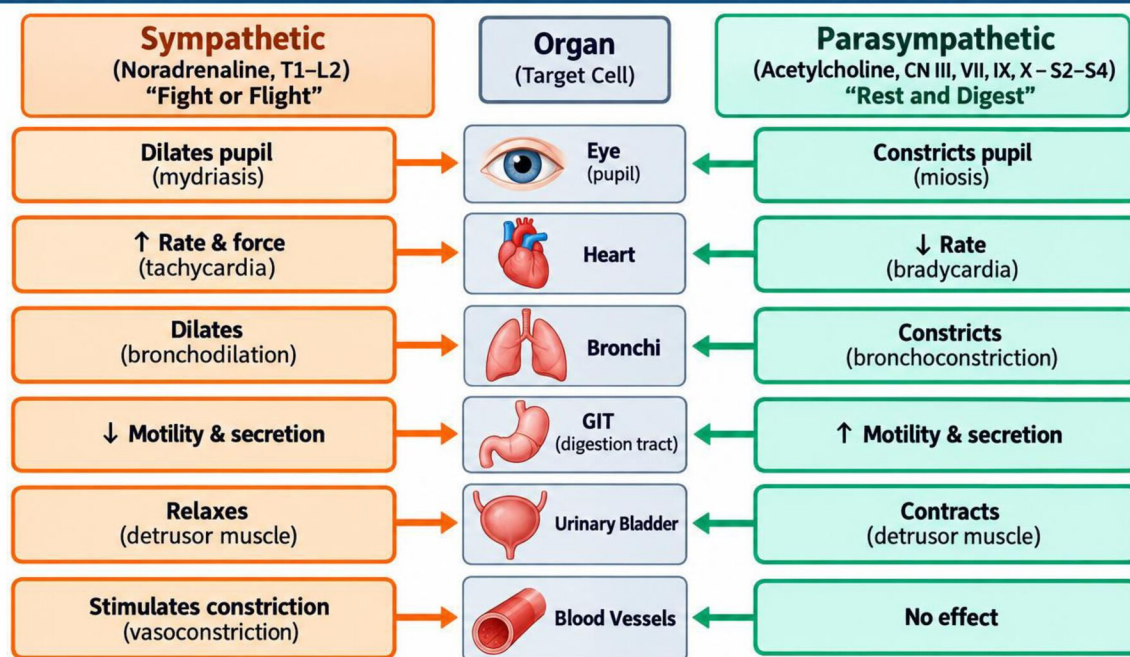


Fig. 1.2 : The two divisions of the ANS primarily act antagonistically on the same target organs.

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Fig. 2 – Sympathetic vs parasympathetic effects

Feature	Sympathetic	Parasympathetic
Origin	Thoracolumbar (T1-L2)	Craniosacral (CN III,VII,IX,X + S2-S4)
Neurotransmitter (postganglionic)	Noradrenaline	Acetylcholine (muscarinic)
Effect	“Fight or flight” – ↑HR, bronchodilation, mydriasis	“Rest and digest” – ↓HR, ↑digestion, miosis

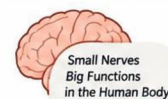
Spinal Nerves

- 31 pairs: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, 1 coccygeal; each is a mixed nerve (dorsal sensory root + ventral motor root).
- Major plexuses: Cervical (C1-C4, phrenic nerve), Brachial (C5-T1, upper limb), Lumbar (L1-L4, femoral nerve), Sacral (L4-S4, sciatic nerve).

Cranial Nerves

The Twelve Cranial Nerves

Name • Type • Chief Function (Quick Revision)



No.	Name	Type	Chief Function
I	 Olfactory	Sensory	Smell
II	 Optic	Sensory	Vision
III	 Oculomotor	Motor	Eye movement, pupil constriction
IV	 Trochlear	Motor	Eye movement (superior oblique)
V	 Trigeminal	Mixed	Facial sensation; chewing
VI	 Abducens	Motor	Eye movement (lateral rectus)
VII	 Facial	Mixed	Facial expression; taste (ant. 2/3 tongue)
VIII	 Vestibulocochlear	Sensory	Hearing and balance
IX	 Glossopharyngeal	Mixed	Taste (post. 1/3 tongue); swallowing
X	 Vagus	Mixed	Parasympathetic to thoracoabdominal organs; speech
XI	 Accessory	Motor	Head/shoulder movement (SCM, trapezius)
XII	 Hypoglossal	Motor	Tongue movement

Mnemonic (names): "Oh Oh Oh To Touch And Feel Very Good Velvet, AH!" | Mnemonic (types): "Some Say Marry Money But My Brother Says Big Brains Matter More"

Fig. 3.1 – The twelve pairs of cranial nerves, their type, and chief function



Fig. 3 – The twelve cranial nerves

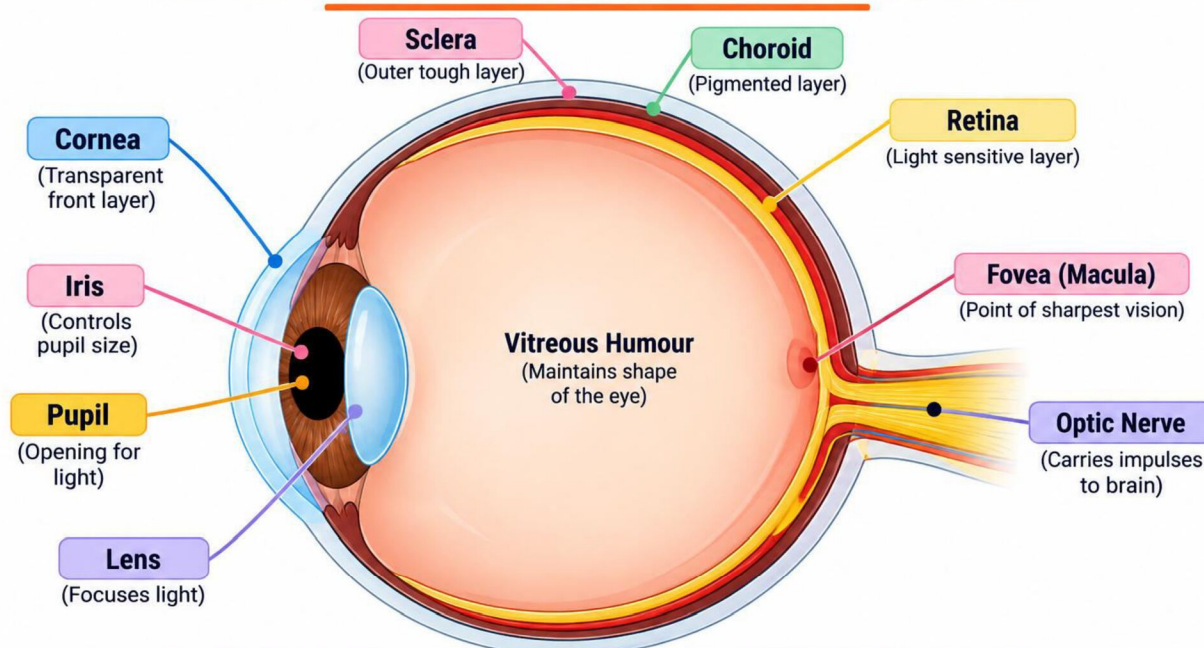
- 12 pairs, numbered I-XII: I Olfactory (smell), II Optic (vision), III Oculomotor, IV Trochlear, V Trigeminal (face sensation/chewing), VI Abducens, VII Facial (expression/taste ant.2/3), VIII Vestibulocochlear (hearing/balance), IX Glossopharyngeal (taste post.1/3/swallow), X Vagus (parasympathetic), XI Accessory (neck/shoulder), XII Hypoglossal (tongue).
- 4 cranial nerves carry parasympathetic fibres: III, VII, IX, X. 4 are dedicated to special senses: I, II, VIII, plus taste via VII/IX.

Reflex Arc

- Receptor → Sensory neuron → Integrating centre (spinal cord) → Motor neuron → Effector. Allows a rapid, involuntary response without brain involvement (e.g. knee-jerk reflex).

2. Special Senses — Eye, Ear, Nose, Tongue

Structure of the Human Eye (Horizontal Section)



The eye focuses light through the **cornea** and **lens** onto the **retina**.

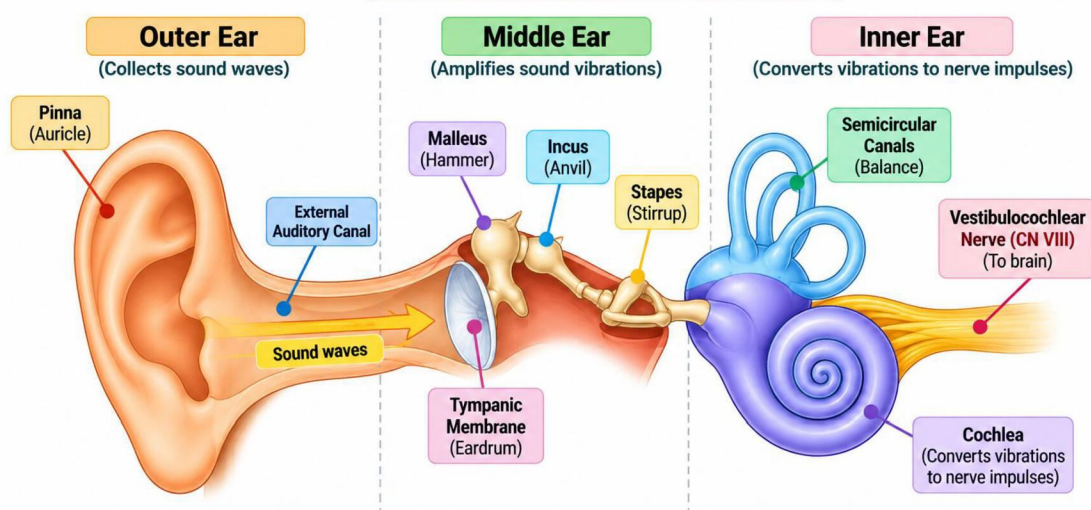
Fig. 4.1 – The eye focuses light through the cornea and lens onto the retina

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Fig. 4 – Structure of the eye

- Eye – 3 layers: Sclera/Cornea (outer, protection/refraction), Choroid/Ciliary body/Iris (middle, nourishment/focus/pupil control), Retina (inner, photoreceptors).
- Rods: dim light, no colour, peripheral. Cones: bright light, colour vision, concentrated at fovea (sharpest vision).

Structure of the Human Ear



The outer, middle and inner ear work together to hear and maintain balance.

Fig. 3.1 – The outer, middle and inner ear, from the pinna to the cochlea and auditory nerve

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Fig. 5 – Structure of the ear

- Ear – Outer (pinna, canal, eardrum) → Middle (ossicles: malleus-incus-stapes, Eustachian tube) → Inner (cochlea = hearing, semicircular canals/vestibule = balance).
- Conductive hearing loss (outer/middle ear problem) vs Sensorineural (cochlea/nerve problem).

Nose & Tongue

- Olfactory epithelium (nasal roof) → olfactory bulb → olfactory tract (CN I) → brain.
- Tongue papillae: Filiform (texture, no taste buds), Fungiform (tip, sweet), Foliate (sides, sour), Circumvallate (back, bitter, V-shaped row). Taste via CN VII (ant. 2/3) + CN IX (post. 1/3).

Physiology of Hearing & Balance

- Sound wave → tympanic membrane → ossicles (amplify) → oval window → cochlear fluid → hair cells (organ of Corti) → CN VIII → auditory cortex.
- Balance: Utricle/sacculle detect linear acceleration; semicircular canals detect rotational acceleration.

3. Pathophysiology of Eye, Ear & Nose Disorders

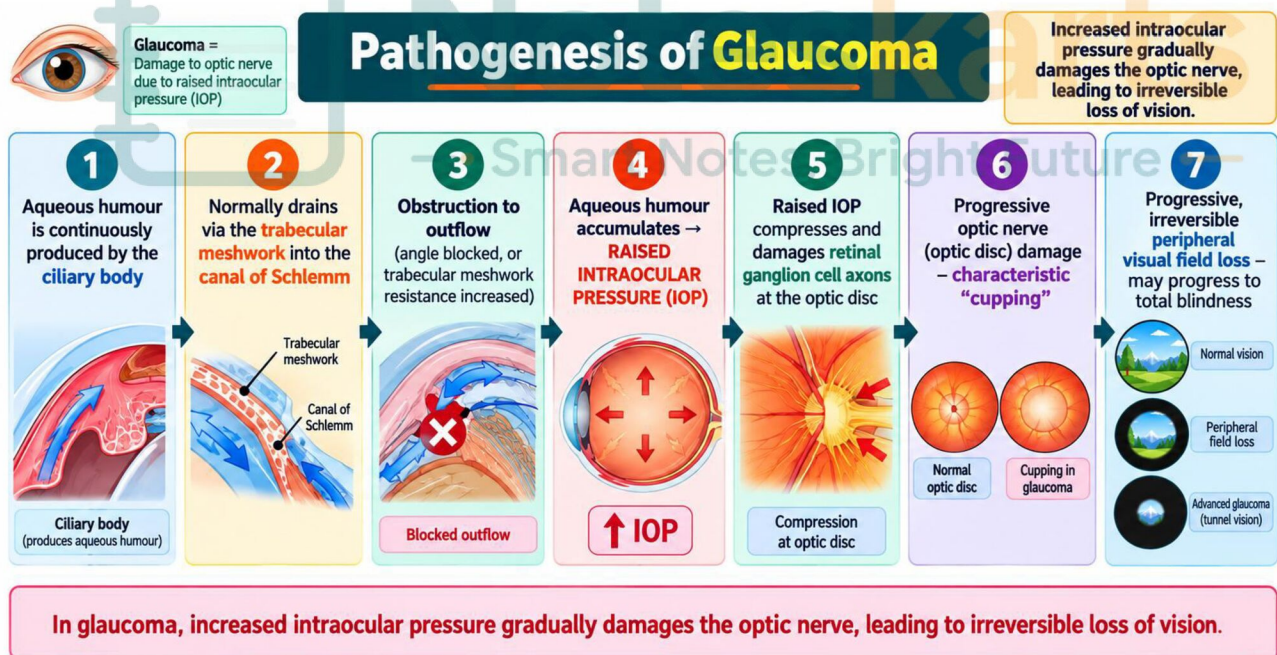


Fig. 8.1 – Raised intraocular pressure progressively damages the optic nerve in glaucoma

Fig. 6 – Pathogenesis of glaucoma

Glaucoma

- ↑ IOP (blocked aqueous outflow via trabecular meshwork) → optic nerve damage → peripheral visual field loss. Open-angle (chronic, gradual) vs Angle-closure (can be acute emergency). Rx: prostaglandin analogues, beta-blockers (topical).

Cataract

- Lens protein (crystallin) opacification, mainly age-related; also diabetes, steroids, trauma, congenital. Progressive painless blurring, glare. Only cure: surgical lens replacement.

Myopia

- Light focuses in front of the retina (eyeball too long / excess refractive power) → blurred distance vision. Corrected with concave (minus) lens. Compare: Hyperopia (focus behind retina, convex lens), Astigmatism (irregular cornea, cylindrical lens).

Otitis Externa vs Otitis Media

Feature	Otitis Externa	Otitis Media
Site	External ear canal	Middle ear cavity
Cause	Bacteria/fungi (water exposure)	URTI → Eustachian tube blockage → bacterial infection
Key sign	Pain on moving pinna/jaw	Bulging red tympanic membrane, fever, common in children

Vertigo

- Peripheral (inner ear/CN VIII – BPPV, Meniere's disease, vestibular neuritis) vs Central (brainstem/cerebellum – stroke, MS). BPPV = dislodged otoconia in semicircular canals.

Anosmia

- Loss of smell. Conductive (nasal obstruction – polyps, sinusitis), Sensorineural (viral damage to olfactory epithelium), Central (head trauma shearing olfactory nerve, neurodegenerative disease).

Rods vs Cones

Feature	Rods	Cones
Light sensitivity	High (dim light)	Low (bright light)
Colour vision	No	Yes
Location	Peripheral retina	Concentrated at fovea

Myopia vs Hyperopia vs Astigmatism

- Myopia: focus in front of retina, concave lens. Hyperopia: focus behind retina, convex lens. Astigmatism: irregular corneal curvature, uneven focus, cylindrical lens.

Open-Angle vs Angle-Closure Glaucoma

- Open-angle: chronic, gradual trabecular meshwork resistance, often asymptomatic until advanced. Angle-closure: iris blocks the drainage angle; can present acutely as a sudden, painful ophthalmic emergency with a red eye and fixed dilated pupil.

Quick-Fire Key Terms

Term	Meaning
Mydriasis / Miosis	Pupil dilation / pupil constriction
Accommodation	Lens shape adjustment to focus on near objects
Nystagmus	Involuntary, rhythmic eye oscillation
Otalgia / Otorrhoea	Ear pain / ear discharge
Presbyopia	Age-related loss of near-focus ability

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