Revision Notes on Neural Control and Coordination

Parts of nervous system

(1) Nervous system is divided into three parts:

(i) Central nervous system (CNS):

(a) In all the vertebrates including man, CNS is dorsal, hollow and non-ganglionated while in invertebrates when present, it is ventral, solid and ganglionated.

(b) CNS is formed of two parts:

Brain – Upper and broader part lying in the head; and

Spinal cord – Lower, long and narrow part running from beginning of neck to trunk.

(ii) Peripheral nervous system (PNS):

(a) It is formed of long, thin, whitish threads called nerves which extend between CNS and body parts (muscles, glands and sense organs).

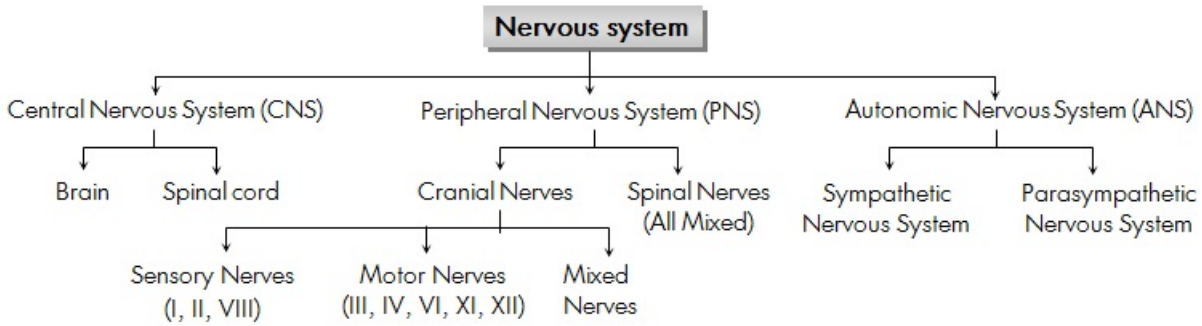
(b) It controls the voluntary functions of the body.

(c) It has cranial and spinal nerves.

(iii) Autonomic nervous system (ANS):

(a) It is formed of nerve fibres extending upto visceral organs and controls the involuntary functions of visceral organs of body like heart beat, peristalsis etc.

(b) It is again formed of two systems: sympathetic and para-sympathetic nervous system which has opposing functions.



Central nervous system:

(1) Central nervous system is made up of brain and spinal cord. CNS is covered by 3 meninges and its wall has two type of matter.

(2) Types of matter: CNS of vertebrates is formed of two types of matter –

(a) Grey matter: It is formed of cell-bodies and non-medullated nerve fibres.

(b) White matter: It is formed of only medullated nerve fibres which appear white due to presence of medullary sheath.

Brain (Encephalon):

It is soft, whitish, large sized and slightly flattened structure present inside cranial cavity of cranium of the skull. In man, it is about 1200-1400 *gm* in weight and has about 10,000 million neurons. Brain is made up of 3 parts

(1) **Fore brain (Prosencephalon)**

(i) Olfactory lobe – Rhinencephalon

(ii) Cerebrum – Telencephalon

(iii) Diencephalon – Diencephalon

(2) **Mid brain (Mesencephalon)**

(i) Optic lobes – Mesencephalon

(3) **Hind brain (Rhambencephalon)**

(i) Cerebellum – Metencephalon

(ii) Medulla oblongata – Myelencephalon

Important areas in the human brain

Area	Location	Function
Premotor area	Frontal lobe	The highest centre for involuntary movements of muscles and ANS.
Motor area	Frontal lobe	Controls voluntary movements of the muscle
Broca's area	Frontal lobe	Motor speech area
Somesthetic area	Parietal lobe	Perception of general sensation like pain, touch and temperature
Auditory area	Temporal lobe	Hearing
Olfactory area	Temporal lobe	Sense of smell
Wernicke's area	Temporal lobe	Understanding speech written and spoken
Gustatory area	Parietal lobe	Sense of taste
Visual area	Occipital lobe	Sensation of light

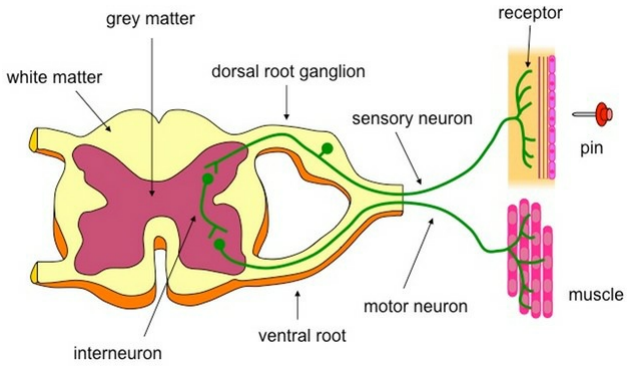
Differences between Cerebrum and Cerebellum

Cerebrum	Cerebellum
(1) It is the largest part of the brain, forming four-fifths of its weight.	(1) It is the second largest part of the brain, forming one-eighth of its mass.
(2) It covers the rest of the brain.	(2) It covers the medulla oblongata only.
(3) It is a part of the forebrain.	(3) It is a part of the hindbrain.
(4) It consists of 2 cerebral hemispheres each comprising 4 lobes : frontal, occipital, parietal, temporal.	(4) It consists of two cerebellar hemispheres and a median vermis.
(5) It encloses 2 lateral ventricles.	(5) It is solid.
(6) White matter does not form arbor vitae.	(6) White matter form arbor vitae.
(7) It initiates voluntary movements, and is a seat of will, intelligence, memory *etc.*	(7) It maintains posture and equilibrium.

Subdivisions, parts and associated structures of a vertebrate brain

Divisions	Subdivisions	Parts	Cavity	Associated strcutures
(I) Prosencephalon (Forebrain)	(1) Telencephalon	Rhinencephalon	I Ventricle (*Rhinocoel*)	Olfactory bulbs Olfactory tracts Olfactory lobes Palaeocortex on pallium
		Cerebral hemispheres	II or Lateral Ventricles	Corpora striata or basal ganglia Corpus callosum Neocortex on pallium Paraphysis
	(2) Diencephalon	Epithalamus (roof)		Habenulae Pineal apparatus Parapineal or parietal
		Thalamus (sides)		
		Hypothalamus (floor)		Hypothalamic nuclei Optic chiasma Median eminence Infundibular stalk Pituitary Saccus vasculosus Mamillary bodies Anterior choroid plexus
(II) Mesencephalon (Midbrain)	–	Crura cerebri (floor)	*Iter* or *cerebral aqueduct*	Cerebral peduncles
(III) Rhombencephalon (Hind brain)	(1) Metencephalon	Cerebellum		Trapezoid body Pons
	(2) Myelencephalon	Medulla oblongata	IV Ventricle (*Metacoel*)	Restiform bodies Pyramids

Reflex action



(1) The reflex actions are involuntary actions because these are not under the conscious control of the brain.

(2) The spinal cord and brain stem are responsible for most of the reflex movements.

(3) A few examples of the reflex actions are withdrawal of hand or leg if pricked by a pin, secretion of saliva as soon as one thinks of delicious food or mere its sight causes salivation, if the body part is touched with acid or hot object it is automatically, without thinking and planning is withdrawn, cycling, motor driving etc.

(4) Component of reflex action: The whole of the reflex are includes six parts –

(a) Receptor organs: Receptors are windows of the body or guards of the body. These are situated on all, important organs, for example – eyes, nose, ear, tongue, integument etc. These perceive the stimuli from outside the body.

(b) Sensory neurons: These are also termed afferent neurons. These carry the stimuli from receptors to spinal cord. These neurons are situated in the ganglion on the dorsal side of spinal cord.

(c) Nerve centre: Spinal cord is termed as nerve centre. Synaptic connections are formed in it.

(d) Association neurons: These are also called intermediate neurons or interstitial neurons. These are found in spinal cord. They transfer the impulses from sensory neurons to motor neurons.

(e) Motor neurons: These are situated in the ventral horn of spinal cord. These carry the impulses to effector organs.

(f) Effector organs: These are the organs, which react and behave in response to various stimuli, for example – muscles and glands.

(5) Type of reflexes: The reflexes are of following types –

(a) Monosynaptic reflex

(b) Polysynaptic Spinal Reflex

(c) Polysynaptic Spinal/Brain Reflexes

(d) Unconditioned or Simple reflex

(e) Conditioned or Acquired reflex

Cranial nerves of mammal at a glance

S.No.	Name	Nature	Origin	Distribution	Function
					Receive stimuli from the

(1)	Olfactory Nerves	Sensory	Olfactory lobe	Sensory epithelium of olfactory sacs	Receive stimuli from the sensory epithelium of olfactory sac and carry them to olfactory lobes
(2)	Optic nerves	Sensory	Optic lobes	Retina in Eyes	Stimulus of light is carried to optic lobes
(3)	Occulomotor nerves	Motor	Crura cerebri	Eye ball muscles, except superior oblique muscle	Carry the impulses from crura cerebri to the eye muscles
(4)	Trochlear nerves	Motor	From in between the optic lobes and cerebellum	Superior oblique muscle of eye ball	Carry the impulses from the brain to superior oblique muscles of the eye
(5)	Trigeminal nerves	Mixed	From the gassarion galglia situated on the lateral side of medulla oblongata	—	—
(i)	Ophthalmic nerve	Sensory	„	Skin of lips	
(ii)	Maxillary	Sensory	„	Upper lip, skin of nose, lower eye lid.	Carry the stimuli from these organs to brain
(iii)	Mandibular nerve	Mixed	„	Lower lip and skin of jaw	Carry the stimuli from these organs to brain
(6)	Abducens nerves	Motor	Medulla	Eye muscles	Carry the impulses from the brain (medulla) to eye muscles
(7)	Facial nerves	Mixed	Behind trigeminal nerve, from geniculate ganglion	—	—
(i)	Palatinus	Sensory	—	In the roof of mouth cavity	Carry the impulses from roof of mouth cavity
(ii)	Hyoman dibular	Motor	—	Muscles of low jaw, muscles of neck and pinna (external ear)	Carry the impulses from brain muslces of lower jaws, neck and pinna.
(iii)	Chordotympani	Mixed	—	In salivary glands and taste buds	Receives the stimuli from the taste buds and carry the stimulus to salivary gland.
(8)	Auditory nerves	Sensory	Medulla	—	—
(i)	Vestibular nerve	„	„	Utriculus, sacculus, semicircular canals and Cochlea.	Receives impulses from the internal ear and carry to brain.
(ii)	Cochlear nerve	„	„	Cochlea	—
(9)	Glossopharyngeal nerve	Mixed	„	Taste buds present in tongue and muslces of oesphagus	Carry sound impulses to brain, to muscles of oesophagus and carry the taste impulse of tongue to the brain
			After arising from		

(10)	Vagus nerve	Mixed	After arising from medulla, 9th and 10th cranial nerves unite to form vagus nerve but become separate and divide into branches	—	—
(i)	Superior laryngeal nerve	Motor	—	Glottis	Carry the impulse to muscle of glottis
(ii)	Recurrent laryngeal nerve	Motor	—	Glottis	„
(iii)	Cardiac nerve	Motor	—	Heart Muscles	From brain to heart muscles
(iv)	Pneumogastric	Motor	—	In the abdominal cavity, in stomach and lungs.	Carry impulse from these organs to brain and from brain to muscles of these organs.
(v)	Depresser nerve	Motor	—	Diaphragm	Carry the impulse to diaphragm
(11)	Spinal accessory	Motor	Medulla	Muscles of neck and shoulders	From brain to muscles of neck and shoulder
(12)	Hypoglossal nerve	Motor	„	Muscles of tongue and neck	From brain to their muscles