

Central Nervous System

- The CNS develops from ectoderm as **mid dorsal** thickening called **medullary or neural plate**. **This** mid dorsal thickening **gradually** transforms **into a neural tube**.
- The anterior end of the neural tube enlarges to become **the brain**, while the remaining part of the neural tube forms the **spinal cord**.
- The protective membranes around the brain and the spinal cord are called **meninges**.
- In mammals **there are** three meninges, an outer tough membrane called **duramater**, middle **arachnoid membrane** and an inner thin vascular membrane called **piamater**
- Cerebro spinal fluid is present between arachnoid membrane and **piamater**.
- Cerebro spinal fluid is secreted from choroids plexus
- The meninges and the cerebrospinal fluid give support to the brain and protect it from shocks.

Brain:

- **This is called encephalon**. Brain lies in the **cranium of the** skull and is protected by it. The encephalon is divided into three main parts:

I. Forebrain or prosencephalon

II. Mid brain or mesencephalon

III. Hind brain or rhombencephalon

I. Fore brain or procencephalon:

- It is the largest part of the brain and includes three parts, (i) two olfactory **lobes**, (ii) two cerebral hemispheres and (iii) a diencephalon.
- These form the anterior most part of the brain. They are two lobes with fused posterior end and anterior end continues as olfactory nerves into the nasal chambers.
- Cerebrum forms the major part of the human brain.
- Cerebrum is longitudinally divided by a deep cleft in to two halves called cerebral hemispheres
- The two cerebral hemispheres are connected by a **broad** transverse **band** of nerve tissue, **called**

corpus callosum.

- The layer of the cells which covers the cerebral hemispheres is called **cerebral cortex**
- The cerebral cortex is referred to as the grey matter due to the higher number of neuron cell bodies
- The cerebral cortex contains motor areas, sensory areas.
- Large region with no specific function present in cerebral cortex are called **Association areas**
- The association areas are responsible for complex functions like intersensory associations, memory and communication
- The inner part of cerebral hemispheres is white in colour called white matter due to the presence of myelinated nerve fibres
- The cerebrum surrounds a structure called **thalamus**
- The major co coordinating center for sensory and motor signalling is **thalamus**
- Structure that lies at the base of the thalamus is **hypothalamus**
- Hypothalamus controls body temperature, urge for eating and drinking and also secretes hypothalamic hormones
- The limbic system is a complex set of structures that lies on both sides of the thalamus, just under the cerebrum. It includes the hypothalamus, the hippocampus, the amygdala, and several others nearby areas.
- Besides the hypothalamus, hippocampus, and amygdala, there are other areas in the structures near to the limbic system that are intimately connected to it:
- The **cingulate gyrus** is the part of the cerebrum that lies closest to the limbic system, just above the corpus callosum
- The **ventral tegmental area** of the brain stem (just below the thalamus) consists of dopamine pathways that seem to be responsible for pleasure.
- The **basal ganglia** (including the caudate nucleus, the putamen, the globus pallidus, and the substantia nigra) lie over and to the sides of the limbic system, and are tightly connected with the cortex above them.
- The **prefrontal cortex**, which is the part of the frontal lobe which lies in front of the motor area, is also closely linked to the limbic system.

It helps in regulation of sexual behaviour, expression of emotional reactions and motivation

II. Mid brain or mesencephalon:

- The midbrain is the smallest region of the brain that acts as a sort of relay station for auditory and visual information.
- Dorsal part is in the form of two pairs of spherical optic lobes called **corpora quadrigemina**.
- The two large anterior optic lobes are called **superior colliculi** and concerned with the sight, while the smaller posterior lobes are called **inferior colliculi** and concerned with hearing.
- The floor of midbrain is formed by thick tracts of fibres called **crura cerebri** that link the fore and hind brains. The optic lobes are without any cavity.
- The dorsal wall of the two optic lobes is internally connected by a transverse strip called **posterior commissure**.
- The cavity of the midbrain is a narrow longitudinal passage called **iter** or **aqueduct of Sylvius**.

III. Hind brain or Rhombencephalon:

- It is divided into two parts :

1. Metencephalon, 2. Myelencephalon.

i. Metencephalon :

- Anteroventral part is called **Pons Varolii** and rest is called **cerebellum**.
- **Pons Varolii**: This is a transverse band of nerve fibres. It connects right and left halves of the cerebellum.
- **Cerebellum**: It is well developed and transversely elongated. It consists of a median lobe called **vermis** and two lateral **lobes** each with a ventro lateral **extension** called **flocculus**.
- The surface of the cerebellum is much folded and is formed by grey matter. The white matter ramifies into the grey matter forming branched strips called **arbor vitae**.
- The pons Varolii and cerebellum are without a cavity.

ii. Myelencephalon:

- It is triangular in appearance and is called **medulla oblongata**. It is the last part of the brain. The cavity of medulla oblongata is called **metacoel**
- The roof of metacoel is non-nervous and vascular. With the piamater it forms **the posterior choroid plexus**.
- **Cavities of the brain**: The brain is hollow within. The cavities are called **ventricles**. The cavity of the olfactory lobe is **rhinocoel**.

- This is continuous with the cavity of the cerebral hemispheres called **paracoels** or **lateral ventricle** or **first** and **second ventricles**.
- The two paracoels connect with each other and **open** into 3rd ventricle or **diacoel** through a passage called **Foramen of Monro**.
- Optic lobes and cerebellum are solid. The cavity of the medulla is called **metacoel** or fourth ventricle. It is connected to the diacoel through **aqueduct of Sylvius** or **iter**.
- **Functions: Olfactory lobes** control the sense of smell. The **cerebral hemispheres** are the seat of thinking, reasoning, memory, intelligence etc., and **Diencephalon** controls perception of chemicals, temperature, reproduction, metabolism and autonomous nervous system.
- First pair of **optic lobes** is concerned with sense of sight. Second pair is concerned with hearing. **Cerebellum** controls and coordinates the voluntary muscular movements.
- **Medulla oblongata** and pons Varolii control the involuntary activities in the body such as digestion, respiration, excretion, circulation etc.

B. The Spinal Cord.

- The medulla oblongata of the brain continues as spinal cord through the **Foramen magnum** of skull. The spinal cord is enclosed in the passage formed by neural canals of successive vertebrae.
- The spinal cord tapers down as non-nervous **Filum terminale**, spinal cord is a sub cylindrical structure, somewhat convex dorsally and flattened ventrally.
- It exhibits **brachial swellings** near the forelimbs and **lumbar swellings** near the hind limbs. A dorsal fissure and a deep ventral sulcus divide the spinal cord into symmetrical right and left longitudinal halves.
- In transverse section, it shows a narrow central canal. The central canal is continuous with the 4th ventricle of the brain.
- The central canal is lined by ependymal cells and filled with cerebrospinal fluid. The spinal cord has outer white matter made up of medullated nerve fibres, and inner grey matter.
- The grey matter contains cell bodies, dendrites and nonmedullated axons. The grey matter is 'H' shaped or butterfly shaped containing dorsal horns and ventral horns.
- The grey horns divide the white matter into dorsal, lateral and ventral funiculi.

The fibres of the **dorsal** funiculus are sensory, those of the **ventral** funiculus are motor, and those of the **lateral funiculi** are both sensory and motor. These fibres are connected to the brain.