

## Examrace

# Nervous system: Behaviour, Brain and Parts for Competitive Exams

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## Central Nervous System (CNS) and Peripheral Nervous System (PNS)

- The brain and its constituent parts are the most complex system ever known. With one trillion separate cells, each one in a continuous process of changing in response to chemical signals.
- From the moment of conception to the moment of death, the biology of the individual is changing.
- It is in this complexity that our species has found the capability to store the accumulated experience of thousands of generations – to create human culture.
- Our language, religions, governments, childrearing practices, technologies, economies are all man-made; yet all depend upon the remarkable capacity of the brain to make internal representations of the external world.

## Biological Bases of Behavior

### The Nervous System

- Endocrine Glands

### The Nervous System

- The system that controls and regulates the structure and function of the brain, spinal cord, nerves, and the nerve cells; it maintains coordination between the nervous system and the rest of the bodily systems.
- It is responsible for the internal communication system that ensures the integrated functioning of the various systems.

### Some Interesting Facts About the Nervous System

- The nervous system consists of billions of highly specialized nerve cells called neurons.
- Nerve impulse is an electrical impulse that travels along the nerves at a speed of around 400km/ hour.
- Every second, a number of these impulses can pass along nerves.
- Brain cells never re grow; once destroyed or dead, they cannot be replaced.

- Nerve fibers are very thin and fine in size; a hundred of them lying side by side would fit into just 1mm.
- The brain is divided into two visible parts or hemispheres; the left hemisphere controls the right side of the body, and the right controls the left side.
- The total surface area of the cerebral cortex is approximately 2.5sq.ft. If you spread it flat.

## Neuron

A nervous system cell is constituted in such a way that it is specialized in receiving, processing, and/or transmitting information to other cells.

### Structure of a Neuron

- **Dendrites:** Receivers of incoming signals; branch fibers extending outward from the cell body.
- **Soma:** The cell body containing the cytoplasm and the nucleus of the cell; cytoplasm keeps it alive.
- **Axon:** The nerve impulses travel from the soma to the terminal buttons through the extended fiber of a neuron i.e., axon.
- **Terminal Buttons:** Swollen, bulblike structures at one end of the axon; the neuron stimulates the nearby glands, muscles, or other neurons
- **Synapse:** the gap between one neuron and the other.
- **Synaptic Transmission:** the procedure through which information is relayed from one neuron to another across the synaptic gap.
- **Neurotransmitters:** The post synaptic neuron is stimulated by the chemical messages released from neurons; they cross the synapse from one neuron to another.

### The Chemical Messages

- The neurons follow an all-or-none law.... either a neuron will be firing or resting /off.
- **Excitatory Message:** The chemical message that makes it more likely that the receiving neuron will fire and the action potential will travel down its axon.
- **Inhibitory Message:** The chemical message that inhibits a receiving neuron from firing so that the action potential does not travel down its axon.

### Major Varieties of Neurons

- **Sensory Neurons (afferent):** they carry messages toward the Central Nervous System from the sensory receptor cells.

- **Motor Neurons (efferent):** they carry messages away from the Central Nervous System toward the muscles and glands.
- **Inter-Neurons:** they relay messages from sensory neurons to other inter-neurons and/or to motor neurons.

## **Main Parts of the Nervous System**

- The Peripheral Nervous System
- The Central Nervous System

## **Central Nervous System (CNS)**

- Brain receives the information from all over the body (primarily in terms of stimulation via sensation), interprets it, and decides how to respond.
- The brain's function is similar to that of a computer; there is a central processing unit (CPU), the output comes in, and the CPU analyses it and responds to it.

## **The Brain**

- The center of the nervous system.
- The vital organ that is responsible for the functions of seeing, hearing, smelling, tasting, thinking, feeling, remembering, speaking, dreaming, information processing, and a lot more.
- The regulator of basic survival functions such as breathing, resting and feeding.
- It is responsible for abstract level functions such as decision making, foresight, and problem solving.
- The spinal cord is an information highway connecting the PNS to the brain.
- Information travels to and from the brain by way of spinal cord.

## **Functions of the Various Structures of the Brain**

- Regulation of the internal systems
- Reproduction
- Sensation
- Motion
- Adaptation to the varying environmental demands

## **Structure of Brain**

- The deeply grooved structure lies safely and securely in our skull.
- The average adult human brain weighs 1.3 to 1.4 kg (approx. 3 pounds).

- If you look at it from the outside the brain is pinkish gray in color; soft, spongy, and mottled.
- The brain contains billions of nerve cells (neurons) and trillions of "support cells".

## Parts of the Brain

**The brain is made of three main parts:**

- a. Fore brain
- b. Mid brain
- c. Hind brain

### **Fore Brain**

- i. Cerebrum
- ii. Thalamus
- iii. Hypothalamus
- iv. Limbic system

### **Mid Brain**

- i. Tectum
- ii. Tegmentum
- iii. Reticular formation
- iv. Substantia nigra

### **Hind Brain**

- i. Cerebellum
- ii. Pons
- iii. Medulla oblongata

## **Brain Stem and Cerebellum**

- Located underneath the limbic system the brain stem, containing four structures, is found in all vertebrates.

**It contains four structures:**

### **1. Medulla**

- Located at the top of the spinal cord and continuous with it.
- Damage to Medulla can be fatal as it is the center responsible for vital functions i.e., respiration, heartbeat, and blood pressure.

- Contains ascending & descending tracts that communicate between the spinal cord & various parts of the brain.
- At medulla, nerves ascending from the body and descending from the brain cross over; hence the left side of the body is connected to the right side of the brain and vice versa.
- **Contains 3 vital centers:**
  - Cardio inhibitory center: regulates heart rate.
  - Respiratory center: regulates the basic rhythm of breathing.
  - Vasomotor center: regulates the diameter of blood vessels.

## **2. Pons**

- Pons = Latin word for bridge
- Bridge connecting spinal cord with brain and parts of brain with each other.
- The pons seems to serve as a relay station carrying signals from various parts of the cerebral cortex to the cerebellum.
- Nerve impulses coming from the eyes, ears and touch receptors are sent on the cerebellum.
- The pons also participates in the reflexes that regulate breathing.
- It has parts that are important for the level of consciousness and for sleep.

## **3. Reticular formation**

- The reticular formation is a region running through the middle of the hindbrain and into the midbrain.
- A dense network of nerve cells.
- It keeps the brain alert even during sleep.
- It makes the cerebral cortex attend to new stimulation by arousing it.
- Long fibrous tracts of reticular formation run into the thalamus.
- Needed for arousal from sleep & to maintain consciousness.
- Serious damage to reticular formation may result into a coma.

## **4. Thalamus**

The pair of egg-shaped structures located at the top of the brainstem.

- Incoming sensory information is channeled to the appropriate area of the cerebral cortex by thalamus, so that it is processed there.

- Thalamus acts like a relay station.... the brain's sensory switchboard; it directs messages to the sensory receiving areas in the cortex and transmits replies to the cerebellum and medulla.
- It receives information from the sensory neurons and routes it to the higher brain regions that deal with vision, audition, taste and touch.
- Cerebellum
- "Cerebellum" comes from the Latin word for "little brain". The cerebellum is located behind the brain stem.
- Cerebellum is somehow similar to the cerebral cortex: the cerebellum is divided into hemispheres and has a cortex that surrounds these hemispheres.
- It carries 10% of the weight of the brain.
- It contains as many neurons as in the rest of the brain.
- Its function is to coordinate body movements i.e. coordination, maintenance of posture & balance.
- Damage to cerebellum results into jerky and uncoordinated body movements.

Responsible for basic survival functions such as breathing, heartbeat, and blood pressure.

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