Unit-3

Bases of Human Behavior

After reading this chapter, you will:

Understand relation between human behavior and biology

Understand Nerve Cell

Understand Nervous System

Understand Different part of brain and its function

Contents

Introduction

Psychology is the scientific study of human behavior. Psychologists have also studied human behavior in relation to different bodily changes and brain functions. Physiological psychologist studies biological factors affecting the behavior of an organism. In this chapter, we will study the structure and functions of a nerve cell, types of Nervous System and structure and function of Brain etc.

Relation between Human Behavior and Biology

Cell is the basic unit of human body. Many cells combine to form tissue. Similarly many tissues form organs and from organ to organ systems are formed. These organ systems perform specific functions of our body. For e.g. digestive system perform the function of digesting food. Circulatory system circulates blood to different body parts. Our body has many such systems. Nervous system has very important role in determining human behavior. Nervous system receives sensations through sensory organs, carries these sensations to brain and the carries back the decisions taken by brain to related organs, muscles etc.

Nerve Cell

Nervous system is made up of specific type of cells which are called nerve cells. These cells are completely different from other body cells in structure and function. Nerve cell is the basic and smallest unit of our nervous system. These cells are also called neurons.

Nerve cells are specialized cells which convert different stimuli into electrical impulse. It receives information, converts it into electrochemical form, and carries it to different cells of our body. It receives information from sense organs and other nerve cells, carries it to Central Nervous System (Brain and Spinal Cord) and then carries the information back to related organs, muscles, glands. This way, Nervous system connects different parts of body with brain and spinal cord and conducts information among them.

Types of Nerve Cells

Neurons are of three types on the basis of functions.

1. Sensory Nerves: Nerves that receive nerve impulse from the receptor cells found in different sense organs of our body that receive sensory information from external environment and carry it to central nervous system i.e. brain and spinal cord. If a person looks at an object, the function of carrying information of that object to brain is done by sensory nerves. These nerves are also called afferent neurons.
2. Motor Nerves: Nerves that carry instructions, information and decisions received from brain and spinal cord to appropriate places: to organs, muscles, glands are called motor nerves for e.g. if a person looks at an object and then the brain's decision to touch that object is carried to muscles of hands by motor nerves. These types of nerves are also called efferent nerves.
3. Association Nerves: These nerves are found only in brain and spinal cord and establish association or connection between sensory and motor nerves.

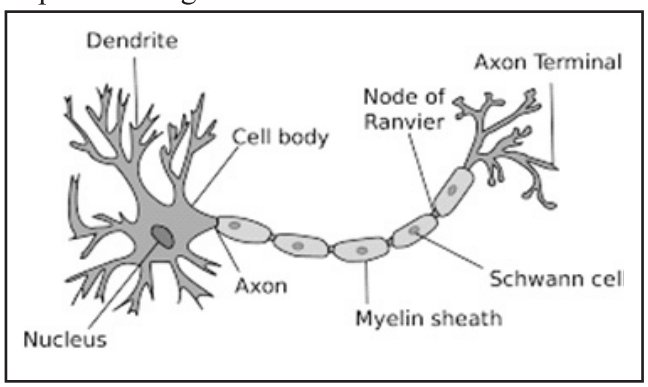
These three types of nerves work in a synchronized manner so that a person can respond to a stimulus.

Structure of Nerve Cell

Human nervous system is made up of 12 billion nerve cells. These cells differ from each other in shape, size, chemical composition and function. Despite these differences, the following three

main components are found in all nerve cells. These are Soma, Dendrites, and Axon.

Soma: Soma is the main part of nerve cell. It contains nucleus and other structures. The genetic material of a nerve cell is being stored in nucleus which enables reproduction and protein synthesis in a cell. Soma is responsible for maintaining life of a nerve cell and keeps it healthy and alive. If soma is damaged then the nerve cell stops functioning. Another function of soma is to receive the nerve impulse through dendrite and transmit it further.



Dendrites: Dendrites are branches that originate from soma. These are the receiving ends of a neuron. Its function is to receive neural signals from the nearby nerve cells or directly from the sense organs. Dendrites contain special receptors that gets activated when they receive any electrochemical or biochemical signals.

Axon: An elongated structure which is attached to soma is called axon. It receives information from soma and sends it to other nerve cells and muscles. Axon carries information through its entire length. Its length varies from many feet in spinal cord to less than one millimeter in brain. The axon, in the end is divided into many small branches which are called terminal buttons. These buttons send information from one neuron to another neuron, gland or muscles. Usually, a neuron conducts information in one direction only that is from dendrite to soma to axon and lastly to terminal buttons. It means that information is received in a neuron from the dendrite end only.

The axon is covered in most neurons by a covering called myelin sheath. This sheath is not found through the axon in continuity but is separated by small ridges type spaces. These spaces are called Nodes of Ranvier. Both myelin sheath and nodes of Ranvier help in increasing the speed of information flow.

Function of Nerve Cell

Nerve cell conducts information in our body. This information flows in the form of nerve impulse in nervous system. Nerve impulse means an electrical current passing through axon for a very short duration. This is called spike. When stimulus energy reaches receptors, then some electrical changes takes place in nerve potential. When the stimulus intensity or energy is very less, then the resulting electrical changes are weak and cannot produce nerve impulse. If the stimulus energy is strong above a certain level, then it generates electrical impulse which is then taken to central nervous system. It means that the strength of nerve impulse is not dependent on the strength of stimulus. Nerve fibers work on the principle of 'All or None law'. Nerve fibers will either respond fully or will not respond at all. The strength of nerve impulse does not increase or decrease with stimulus intensity.

Synapse: Information flows in the form of nerve impulse in nervous system. One neuron can carry information only through the length of its axon. But when information is to be sent to distant body parts then so many neurons participate in this process. One neuron sends information to another neuron, which sends information to other neuron

and so on. One neuron is not physically attached to other neurons rather they are separated by a small space in between both the neurons. This space is called synapse.

Information is passed through the synapse by a specific process. The nature of nerve impulse conduction is electrochemical in axon. But the nature of synaptic transmission is chemical. These chemicals are known as neurotransmitters.

Nervous System

Human nervous system is well developed but complex in comparison to other organism. Although nervous system works as a unit in totality basis, but then also nervous system can be divided into two parts on the basis of location: Central Nervous System and Peripheral Nervous System.

The part of nervous system which is found inside skull and vertebral column is called central nervous system. It consists of brain and spinal cord.

Peripheral nervous system can further be divided into somatic and autonomic nervous system. Somatic nervous system controls voluntary bodily functions whereas autonomic nervous system controls those functions on which we have no control.

Central Nervous System

Central nervous system is the centre of all neural activities. It organizes all incoming sensory information, controls all cognitive activities and provides motor control over muscles and glands. It is assumed that human brain has developed periodically during millions of years from the brain of primitive animals and this development process is still continued. The weight of an adult human brain is approximately 1.36 kg and it contains 100 billon nerve cells. Brain has many structures which perform specific functions.

Brain

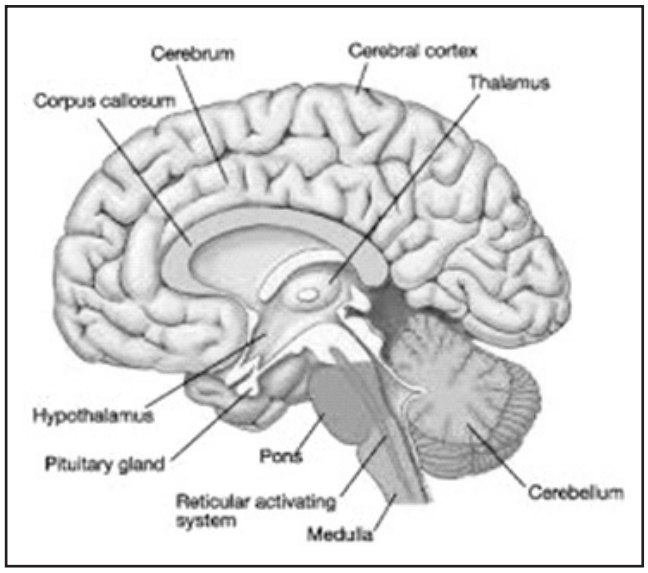
Brain is located inside the skull. For the ease of study, brain can be divided into three parts.

Forebrain: It consists of thalamus, hypothalamus and cerebrum.

Midbrain: It is located between forebrain and hindbrain.

Hindbrain: It consists of medulla, pons and cerebellum.

Forebrain: Forebrain is considered the most important part of brain as it performs all cognitive, emotional and motor activity. Now, we will discuss some important parts of forebrain: hypothalamus, thalamus and cerebrum.



Hypothalamus: It is one of the smallest parts of brain but it plays a major role in determining behavior. It regulates the physiological processes of emotional and motivational behavior such as eating, drinking, sleeping, regulation of body temperature and sexual arousal etc. It also regulates and controls internal environment of the body by controlling activities such as heart rate,

blood pressure, levels of hormones (secretions of various endocrinal glands).

Thalamus: It is an oval shaped structure located on the upper part of hypothalamus. It works as a 'relay station' which sends sensory signal received from sensory organs to appropriate part of the brain. It also sends the output motor signals received from brain to appropriate body parts.

Cerebrum: This is also known as cerebral cortex. It performs all higher level cognitive activities such as attention, perception, learning, memory, language and problem solving etc. Cerebrum consists of two third of the total area of the brain. Its thickness varies from 1.5 mm to 4 mm which entirely covers the surface of brain. Cerebrum is divided into two equal halves which are called cerebral hemispheres. Although both hemispheres are similar in appearance but their functions are different. For e.g. left hemisphere controls language related behavior whereas right hemisphere controls activities related to images, spatial relations, pattern recognition etc. Both hemispheres are connected to each other by a bundle of nerve fibers known as corpus callosum. It communicates messages between both the hemispheres.

Midbrain

It is relatively smaller in size and connects both forebrain and hindbrain. It consists of visual and auditory sensory centers. An important part of midbrain is reticular activating system (RAS) which is responsible for emotional behavior. It makes us alert and active by regulating sensory information. It also helps us in selecting information from environment.

Hindbrain

Medulla oblongata: It is lowest part of brain which is attached to spinal cord. It regulates basic life saving activities such as breathing, heart rate and blood pressure. That is why medulla is called vital centre of the brain.

Pons: Pons is attached to medulla on one side and to midbrain on the other side. Pons receives auditory signals transmitted by our ears. Pons is considered to be related with our sleep system specially with dream sleep. It contains nuclei that affect facial expressions and inhalation-exhalation process.

Cerebellum: This is most developed part of the hindbrain. It can be easily identified due to its rough surface. It controls and maintains body postures and balance. It is cerebellum due to which we don't need to focus too much on our postures while performing activities such as walking, riding a bicycle or dancing.

Spinal Cord

It is a bundle of nerve fibre shaped like a long rope which is located inside vertebral column to its entire length. It is attached to medulla of brain on one side. The other side is freely extended like a tail. The inside structure is same in its entire length. The mid part of spinal cord is shaped like butterfly which is made up of grey matter. Circling this grey matter is white matter of spinal cord.

Spinal cord performs two major functions: first it send sensory signals received from lower parts of body to brain and taking motor impulse received from brain to different body parts, second it also controls some reflex actions.

Reflex Action: Reflex action is an involuntary action which happens immediately after a specific stimulation. Reflex action takes place without

conscious decision of brain. For example blinking of eyes is a reflex action. When any object suddenly comes close to our eyes, our eyes blink. Our nervous system performs many reflex actions like contractions of pupils in the eye, immediately removing hands when touched by a very hot or very cold. These reflex actions are directly controlled by spinal cord in which brain does not play any role.

Peripheral Nervous System

Peripheral nervous system (PNS) includes all those nerve cells and nerve fibers that connect central nervous system to out body parts. Peripheral nervous system is divided into somatic nervous system (SNS) and autonomic nervous system (ANS). Autonomic nervous system is further divided into sympathetic and parasympathetic nervous system. PNS connects central nervous system and different parts of our body. It receives information from sense organs and sends it to brain and carries back the motor responses to muscles, glands and related body parts.

Somatic Nervous System

It consists of two types of nerves: Cranial Nerves and Spinal Nerves. There are total 12 pairs of cranial nerves which originate from different brain parts. There are total 31 pairs of spinal nerves which originate from spinal cord. Spinal nerves have two functions. The nerve fibres of spinal nerves collects sensory information from different body parts (except brain) and take it to spinal cord from where sensory information is sent to brain. Spinal nerves also similarly take back the motor decisions of brain to different body parts, muscles and glands.

Autonomic Nervous System

It regulates those actions which are not in our control. It controls internal activities such as breathing, blood circulation, salivation, stomach contractions and emotional reactions. These activities of autonomic nervous system are in control of different parts of brain. Autonomic nervous system has two divisions – sympathetic and parasympathetic nervous system. Although both these systems have effects opposite to each other but both these system work together to maintain balance.

Sympathetic nervous system: It controls emergency situations when strong and urgent actions are required for e.g. in the case of fight or flight response. In such emergencies, digestive activities are lessened, blood flows towards muscles and breathing rate, oxygen supply, heart rate and level of blood sugar increases.

Parasympathetic nervous system: it is related mainly to conserving energy. It conducts the routine activities of internal system of our body. When emergency situation ends, parasympathetic system takes over. It lower the activities of sympathetic system, restores the person to normal levels resulting in normalcy of heart rate, breathing rate and normal blood flow.

It can be concluded that all parts of nervous system play a very important role in determining human behavior.

Main terms:

Nerve cell, dendrites, axon, central nervous system, spinal cord, reflex action, peripheral nervous system, somatic nervous system, autonomic nervous system

Important Points:

In this chapter, the relation of human behavior and biology is described.

The cell is the basic unit of human body. Many cells form tissue, many tissue to organ, many organs to organ systems are formed. These organ systems perform specific functions of our body.

Nerve cell is the basic and smallest unit of nervous system. It is also called neuron.

Nerve cells are of three types on the basis of functions: Sensory, motor and association neurons.

Nerve cells perform the function of transmitting information in our body.

Nervous system is of two types: Central Nervous System and Peripheral Nervous System.

Central Nervous system consists of brain and spinal cord.

Peripheral nervous system is divided in two parts somatic nervous system and autonomic nervous system.

Practice Questions

Multiple choice Questions

1. Which part of nerve cell contains nucleus?
   A. Axon
   B. Soma
   C. Myelin Sheath
   D. Nodes of Ranvier
2. Which part of nerve cell increases the speed of nerve conduction?
   A. Myelin Sheath
   B. Dendrites
   C. Thalamus
   D. Pons
3. Which part of brain controls activities like eating, drinking, sleeping, temperature regulation and sexual arousal?
   A. Pons
   B. Cerebellum
   C. Hypothalamus
   D. Thalamus
4. How many pairs of cranial nerves are there in human brain?
   A. 6
   B. 10
   C. 12
   D. 31

Very Short Answer Questions

1. Which are three important parts of a nerve cell?
2. Name three types of nerve cells.
3. What is the meaning of Somatic nervous system?
4. Give an example of reflex action.

Short Answer Questions

1. Which part of nerve cell receives nerve impulse from other nerve cells?
2. What is the function of sensory nerves?
3. What are different types of nervous system?
4. What is the function of somatic nervous system?
5. What is the function of autonomic nervous system?

Long Answer Questions

1. Describe the structure of nerve cell with the help of a diagram.
2. Describe the types and functions of nerve cell.
3. Describe the structure of brain with the help of a diagram.
4. Describe the structure and functions of spinal chord.
5. Differentiate between somatic nervous system and autonomic nervous system by giving examples.

Answers to Multiple Choice Questions:

1. B 2.A 3.C 4.C