# Venus Bhatnagar Science Institute

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Science Institute

## Control and Coordination

Class - 10th,Subject - chemistry



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20 years of success

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# Table of Contents

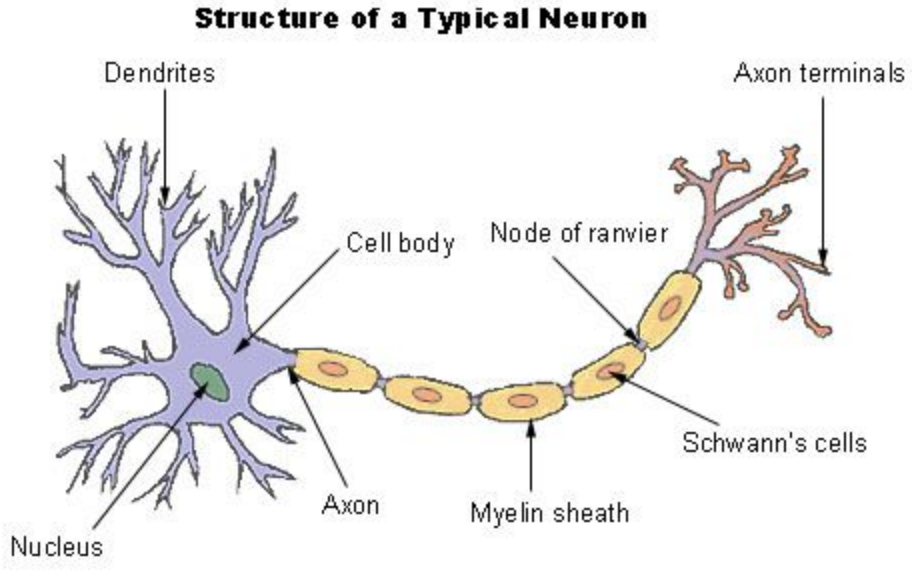
# Control and Coordination

## Animals - Nervous system

The nervous and muscular tissues provide control and coordination in animals. The nervous system consists of specialized nerve cells called neurons. The neurons together form the central nervous system which consists of the brain and the spinal cord. The neutrons in the nerves serve as the link to communicate between the central nervous system and all parts of the body. If we touch a hot pan accidently, we immediately withdraw our hand from it. The information sensed is detected by the specialised types of nerve cells known as receptors.

### Structure of a Nerve Cell or Neuron

A nerve cells or neuron is the structural and functional unit of nervous system that receives, conducts and transmits impulses. The neurons are of three types : motor neurons, sensory neurons and relay neurons. The impulses are carried from the sense organs to the central nervous system by the sensory or afferent neurons. The relay neurons build connections to other neurons inside the central nervous system. They are also called interneurons. They have numerous short fibres where each fibre is a thread like extension of a nerve cell. Each neuron is made up of three parts: cell body, dendrites and axon.



1. Cell body: The cell body or cyton consists of a nucleus that is surrounded by cytoplasm and other organelles except centrioles. The neurons are hence incapable to divide as they lack centrioles. The cytoplasmic matrix of the cell body is known as neoplasm. The nucleus in the cell body is large and contains a prominent nucleolus. Nissl granules are small ribosomes contained in the cell body along with fine fibrils called neurofibrils.
2. Dendrites : Dendrites are short and branched protoplasmic processes of the cell body that receive impulses from other neurons and transit them towards the cell body. They consist of Nissl granules and neurofibrils.
3. Axon: a long fibre like cytoplasmic process that transmits impulses away from the cell body is called axon. The axon terminal branches are called telodendria or terminal arborizations. An insulating and protective sheath of myelin is present around the axon. It consists of neurofibrils. The Dendrites and axon both arises from the cell body of a neuron.

## Transmission of Impulse

The information is transmitted in the form of impulses through the neurons. Impulse is a series of electrical pulses travelling down the nerve fibre. The pathway for transmission of an impulse is as shown.
Stimulus -> Dendrite -> cell body -> Axon -> axon terminal -> passage of stimulus

Key points:
Neurotransmitter is a chemical substance that is used by a neuron to signal another neuron.

## Synapse

Synapse is a narrow gap consisting of communicating junction between two neurons. Is is the area of contact between the axon terminal of one neuron and the dendrite terminal of the next neuron. A synapse consists of presynaptic knob, post-synaptic depression and synaptic cleft.

1. A presynaptic knob or bouton is formed on expansion of axon terminal
2. A Post-synaptic depression is formed when the dendrite terminal is slightly broadened and depressed.
3. A synaptic cleft is a narrow space filled with fluid that occurs between the presynaptic knob and the post synaptic depression.

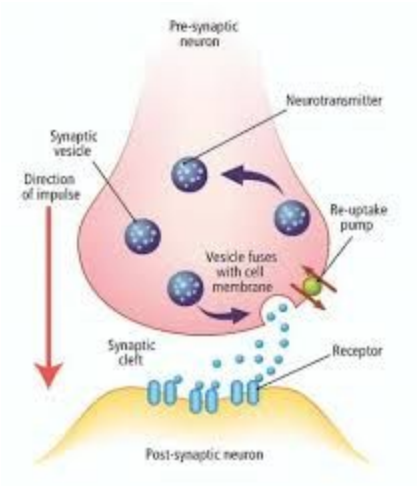



Fig. Transmission of nerve impulse across the synapse

## Reflex Action

A reflex action is an automatic response to any change in the intrnal or external environment of an organism. For instance, the pupil of the eye contracts when a bright light shines in the eye. This reflex cannot be stopped and we are not even aware that it is occuring. Similarly, when a food particle touches the lining of the windpipe, it sets off a coughing reflex which cannot be suppressed.
The reflexes are of two types: natural or inborn reflexes and conditioned or acquired reflexes.

## Reflex Arc

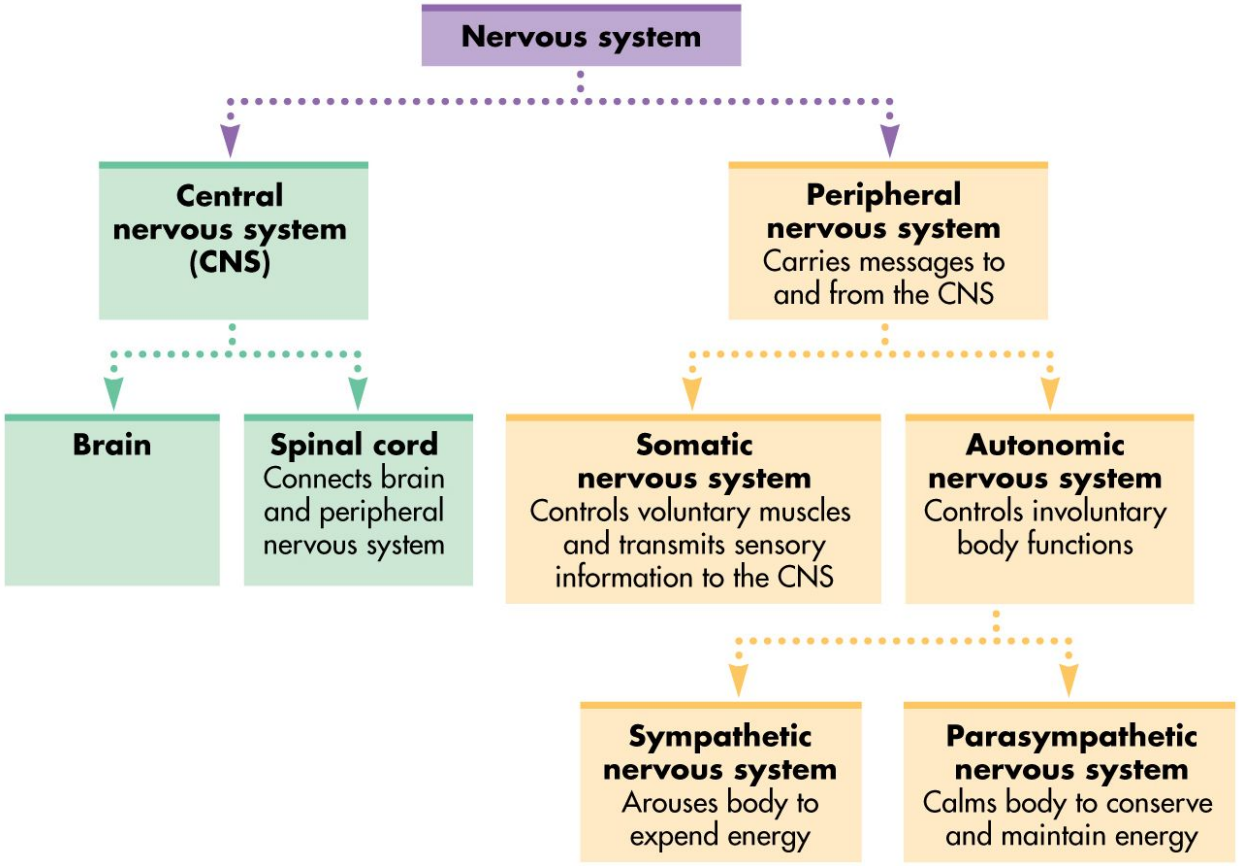
Reflex arc is the pathway that a stimulus takes to travel from receptor organ to effector organ. The sequence of events occuring in a simple reflex arc is as shown
Stimulus -> Receptor -> Sensory Neuron -> Spinal Cord -> Motor Neuron -> effector -> Response

1. Receptor : It is a tissue or organ such as eye or ear that receives the stimulus to initiate the nerve impulse.
2. Sensory Neuron: It transmits the impulse from receptor to central nervous system.
3. Spinal cord : The spinal cord in the central nervous system causes most of the apparent reflexes originating in the trunk and limbs of the body, for example, In reflex and withdrawal of hand or food on being pricked.
   Brain also plays in the reflex arc mechanism in some cases such as closing of eyelids when bright light falls on them and peristalsis.
   The impulse is transmitted from the sensory neuron to motor neuron through the relay neuron in the central nervous system. However processing of the impulse does not occur during reflex action.

4. Motor Neuron : It transmits the motor impulse from the central nervous system to the effector organ.
5. Effector Organ : It is a muscle, gland or organ that is activated by motor impulse in order to provide a suitable response to the stimulus.

## Human Nervous System

The Human nervous system has two parts the central nervous system and the peripheral nervous system. The central nervous system includes the brain and the spinal card. The peripheral nervous system voluntary nervous system and the involuntary or autonomic nervous system. The voluntary peripheral system consists cranial nerves arising from the brain and the spinal nerves arising from the spinal cord. The involuntary or autonomic nervous system consists of two parts : sympathetic nervous system and parasympathetic nervous system. They govern the functioning of various internal body parts.




### Human Brain

The brain is a part of CNS and is the main coordinating centre of the body. An adult human brain weigh about 1300 to 1400 g. The brain is located in the skull and is protected by a body box called cranium. Is is covered by three connective tissue layers known as meninges. These layers/ membraned contain cerebrospinal fluid between them which connective tissue layers

known as meninges. These layers contain cerebrospinal fluid between them which protects the brain against any mechanical shock. The brain is divided into three parts : forebrain, midbrain, and hindbrain.

### ForeBrain

The largest and main thinking part of the brain is forebrain. It consists of olfactory lobes, cerebrum and the diencephalon.

1. Olfactory lobes: the olfactory lobes are a pair of very small, solid, club-shaped bodies widely separated from each other. They can be seen on the inferior surfaces of cerebrum. Each olfactory lobe has an anterior olfactory bulb and a posterior narrow olfactory tract. The function of olfactory lobes is to transmit sense of smell received from the olfactory epithelium to the temporal part of the cerebrum.
2. Cerebrum: It is the largest part of the forebrain and consists of sensory areas to receive impulses from the sense organs such as eyes, tongue, nose and skin. It is present on the front, lateral and superior parts of the brain. Cerebrum is divided into two large, deeply convoluted parts called cerebral hemisphere separated by a longitudinal cerebral fissure.
3. Diencephalon: it encloses a slit like cavity called the tird ventricle and is located on the inferior side of the cerebrum. The thin roof of this cavity is called epithalamus. The thick right and left sides are called thalami and the floor is called hypothalamus.

### MidBrain

It is a small part of the brain having two thick fibres and four swellings. The fibrous tracts called cerebral peduncles or crura cerebri connect the hindbrain with the forebrain. The swellings called corpora quadrigemina or colliculi are associated with reflex movements of head neck and truck. They respond to stimuli of light, sight and sound. The centres for sight reflexes are present in the two superior colliculi or corpora quadrigemina and the centres of auditory reflexes are present in the two inferior corolla quadrigemina.

### Hindbrain

It consists of three main parts : cerebellum, pons and medulla oblongata. The midbrain, pons and medulla oblongata collectively form brainstem.

1. Cerebellum - It is a small area located behind cerebrum and above medulla oblongata. It is the second largest part of the brain. It has two large furrowed lateral cerebellar hemispheres and central worm like vernis. Like cerebrum, it also has an outer cortex made up of grey matter.
2. Pons (Pons varolii) : the pons varoli is located in the centre of the brain below the cerebellum and acts like a bridge. It helps in coordinating muscular movements of both sides of the body. It also serves like a relay station between cerebellum, spinal cord and rest of the brain. In the pons, the nerve tracts between the brain and the spinal cord cross from the left side to the right side.

3. Medulla oblongata : it is the lowest part of the brain and is represented by the swollen tip of the spinal cord. It continues posteriorly into the spinal cord. It consists of fluid filled cavity known as fourth ventricle.

## Spinal Cord

The spinal cord is about 43-45 cm long, tube like structure. It extends downwards from the medulla of the brain to the end of the vertebral column. The vertebral column is
A bony covering that surrounds and protects the spinal cord. The spinal cord is also surrounded by meninges. The spinal cord resembles like a hollow.
The outer tube is made up of nerve fibres with white matter and the inner central tube is grey matter. This distribution of white and grey matter is just opposite to that of the brain.

**Function of spinal cord**
The main functions of spinal cord are as follows

1. It acts as the main center for reflex action.
2. It relays messages from the brain to the motor nerves in the rest of the body and also from the sensory nerves to the brain.
3. Simple reflex responses, for example can take place through the action of spinal cord only.
4. It relays a;; signals transmitted between the brain and the peripheral nervous system.

## Peripheral Nervous System

1. Voluntary peripheral nervous system
2. Involuntary Peripheral Nervous system
3. Sympathetic Nervous System
4. Parasympathetic Nervous System

Difference between the functioning of sympathetic nervous system and parasympathetic nervous system

| Sympathetic Nervous System | ParaSympathetic Nervous System |
|---|---|
| 1. It increases the contraction of cardiac muscles and rate of heartbeat. | It decreases the contraction of cardiac muscles and rate of heartbeat. |
| 2. It dilates bronchi and bronchioles of lungs. | It consists bronchi of lungs |
| 3. It inhibits the gastric secretions | It stimulates the gastric secretions |

| | |
|---|---|
| 4. It relaxes urinary bladder | It contracts urinary bladder |
| 5. It constricts blood vessels | It dilates blood vessels |
| 6. It stimulates muscles attached to the hair and causes them to become erect. | It causes hair to lie flat. |
| 7. It increases the secretion of sweat glands | It decreases the secretion of sweat glands. |

## Coordination in plants

1. Positive response: the response that is favourable or towards the stimulus is called positive, for example positive phototropism.
2. Negative response : the response that is unfavourable or away from the stimulus is called negative. For example, Negative geotropism.

### Tropic Movements of growth

These movements generally take place in stems and roots. They are of the following types: Phototropism, geotropism, hydrotropism, thigmotropism and chemotropism

1. Phototropism: the directional growth movements of curvature in response to illumination by a unidirectional light is called phototropism.
2. Geotropism: The directional growth movements of curvature occurring in response to the gravitational pull is called geotropism.
3. Hydrotropism: The directional growth movements of curvature occuring in response to the unidirectional stimulus of water is called hydrotropism.
4. Thigmotropism: the directional growth movements of curvature occuring in response to stimulus of contact is called thigmotropism.
5. Chemotropism: The directional growth movement of curvature occuring in response to a chemical stimulus is called chemotropism.

Different between tropic movements and Nastic Movements

| Tropic Movements | Nastic Movements |
|---|---|
| These are directional movements | These are non directional movements |
| These can occur in response to the stimulus or away from the stimulus | These neither occur in response to the stimulus nor away from the stimulus |
| These are curvature movements caused due to unidirectional growth | These are variation movements caused die to turgor changes. |

## Growth Independent Movements

The movements that occur as an instant response to the stimulus are called growth independent movements.

## Chemical coordination in plants

Different plant hormones are auxins, gibberellins, cytokinins, ethylene and abscisic acid.

1. Auxins are organic substance. The auxins are produced in apical meristems, young flower buds, young leaves and developing seed. Indole 3-acetic acid is the most common natural auxin.
   **Functions of Auxins**
   1. Cell elongation
   2. Apical Dominance
   3. Respiration
   4. Fruit Growth
   5. Root induction
   6. Parthenocarpy
   7. Flowering
2. Gibberellins : Gibberellins are plant hormones that cause cell elongation of leaves and intact stems.gibberellic acid is the most common gibberellin.
   **Functions of Gibberellins**
   1. Growth
   2. Leaf expansion
   3. Overcoming dormancy
   4. Parthenocarpy
   5. Fruit Size
   6. Flowering
3. Cytokinins : Cytokinins are the plant hormones that promote cell division in plants. Zeatin was the first natural cytokinin discovered. Kinetin is a synthetic cytokinin, the synthetic of cytokinins occurs in root tips from where they go to shoots. They are synthesised in endosperm of developing seeds.
   **Functions of Cytokinins**
   1. Cell divisions
   2. Differentiation
   3. Apical dominance
   4. Phloem transport
   5. Resistance
   6. Flowering
4. Ethylene : Ethylene is a gaseous hormone that enhances transverse growth and fruit ripening however, the longitudinal growth is inhibited by ethylene. The synthesis of

ethylene occurs in all parts but it is majorly synthesised during ripening of certain fruits like apple, melon and banana, these fruits are called climacteric fruits.

**Functions of Ethylene**

1. Growth
2. Senescence
3. Abscission
4. Ripening of fruits
5. Dormancy

5. Abscisic Acid: Abscisic acid is growth inhibitor that retards or suppresses the growth. Due to this, it is known as stress hormone or dormin as it causes dormancy to overcome stress conditions.

**Function of Abscisic acid**

1.Growth
2.Transpiration
3. Dormancy
4. Wilting and senescence
5. Abscission