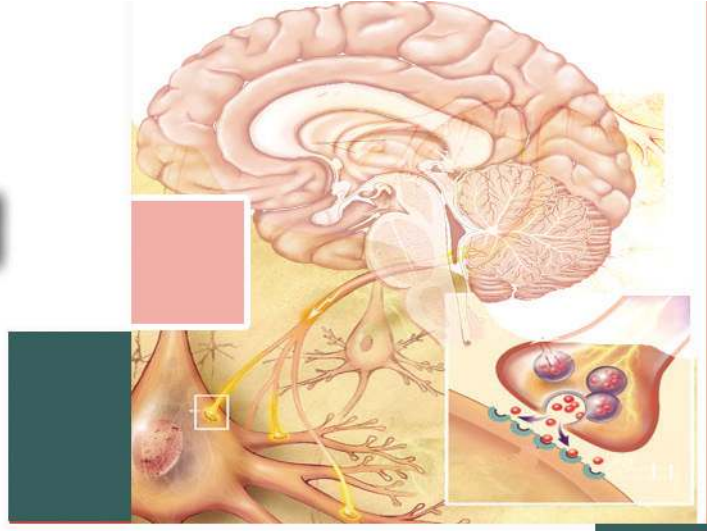
1 Sensations and Responses



Observe the picture. Children and other organisms have a variety of experiences. What are they?

- a child tasting a mango.
- a snail withdrawing its body into the shell when it is touched.
-

What are the factors to which children and other organisms respond here?

- taste
- touch
-
-

The senses that evoke responses in organisms are called stimuli. Do we recognise stimuli only from our immediate surroundings?

Hunger and thirst are stimuli formed inside the body, aren't they? Find out more examples for such stimuli.

How does the body receive stimuli?

Observe illustration 1.1 and form inferences.

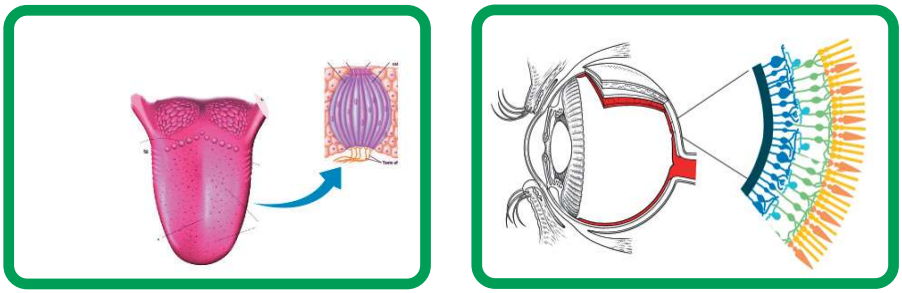


Illustration 1.1 Specialized cells that receive stimuli

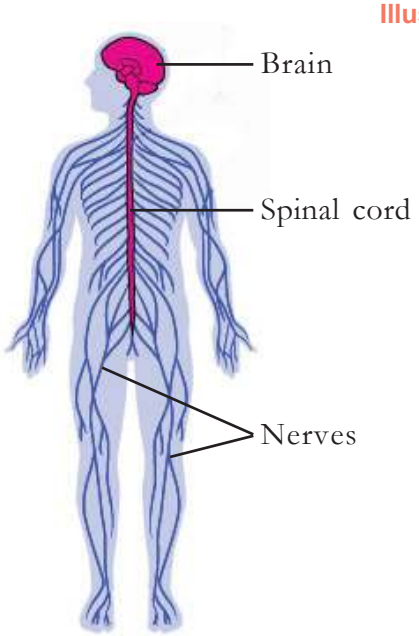


Figure 1.1 Nervous system

There are specialized cells in the sense organs and other parts of the body to receive stimuli. These cells are known as receptors. They receive stimuli and generate suitable impulses.

Normally, responses occur when the impulses generated by the receptors on receiving the stimuli reach the brain. The nervous system controls and co-ordinates these actions.

Analyse figure 1.1 and find out the major parts of the nervous system.

Neuron

Neuron or nerve cell is the basic structural unit of the nervous system. Like all other cells, the neuron has a cell membrane, cytoplasm and nucleus. Analyse illustration 1.2 and tabulate the main parts of a neuron, its characteristics and function. Write them down in the Science diary.

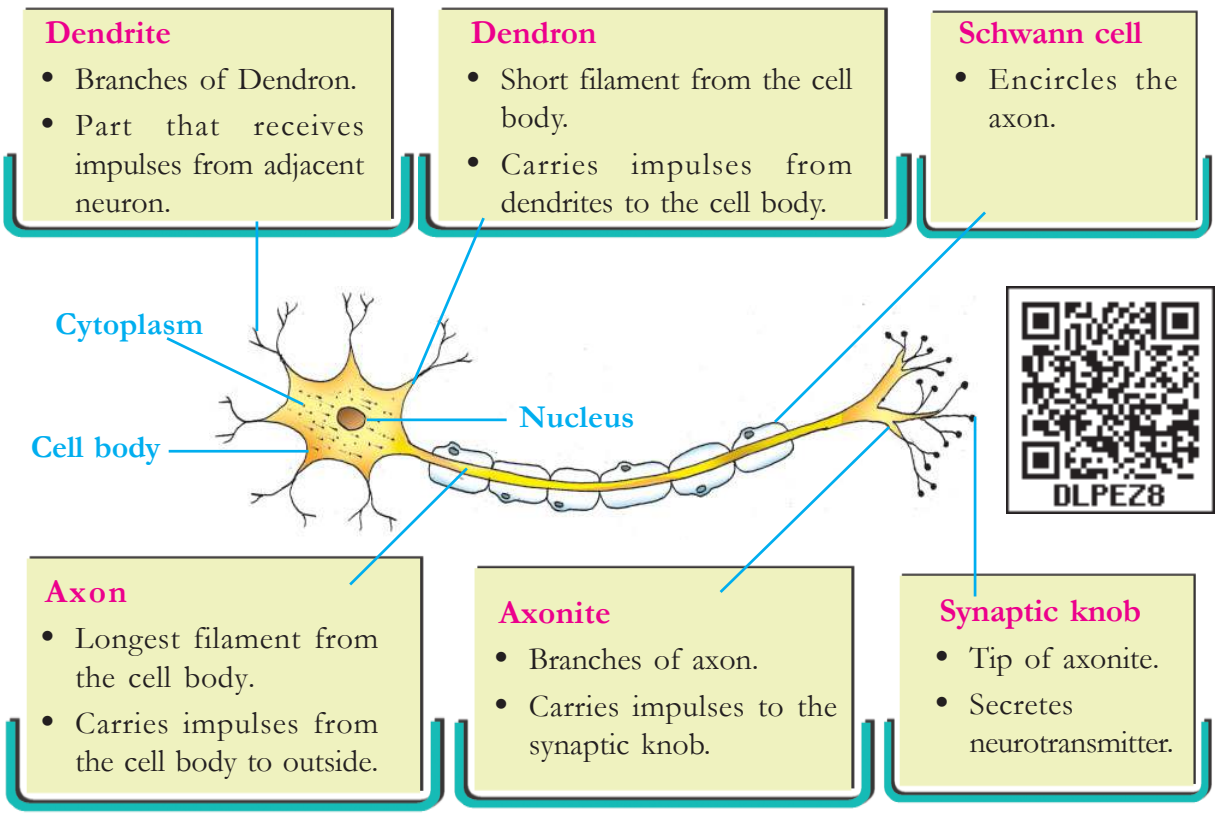


Illustration 1.2 Neuron - Structure and function

Axons of most of the neurons are repeatedly encircled by myelin, a membrane containing lipid. This is called myelin sheath. Analyse illustration 1.3 and the description. Find out the characteristics and significance of myelin sheath and prepare a note on the basis of the indicators given.

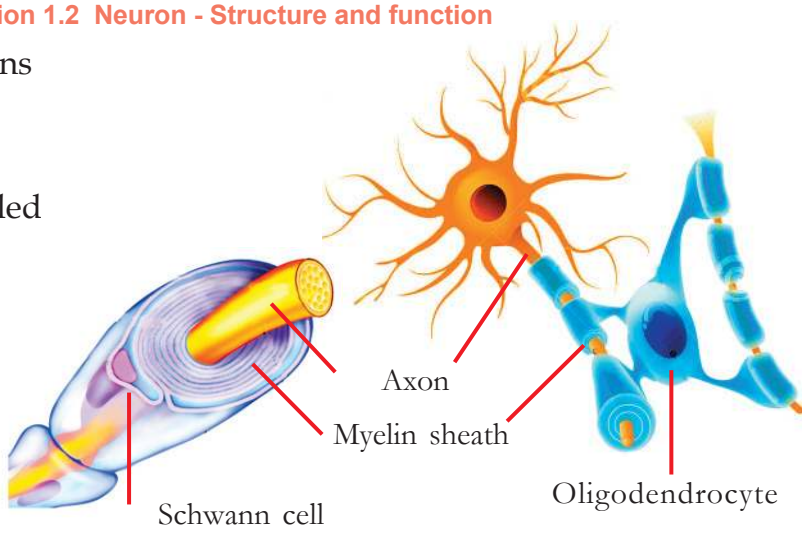


Illustration 1.3 Formation of myelin sheath

Oligodendrocytes and Schwann cells

Oligodendrocytes and Schwann cells provide protection to neurons. An oligodendrocyte constructs myelin sheath by covering the different axons simultaneously or by covering the different parts of the same axon repeatedly.

Myelin sheath made up of Schwann cells are seen in the axons in nerves. A Schwann cell encircles the axon repeatedly.

Nerve is a group of axons. Myelin sheath in the nerves is formed of Schwann cells. Myelin sheath in the brain and the spinal cord is formed of specialized cells called oligodendrocytes. The myelin sheath has a shiny white colour. The part of the brain and the spinal cord where myelinated nerve cells are present in abundance is called white matter and the part where non-myelinated nerves cells are present is called grey matter.

The major functions of the myelin sheath are to provide nutrients and oxygen to the axon, accelerate impulses, act as an electric insulator and protect the axon from external shocks.

Indicators

- Formation of myelin sheath.
- Grey matter, white matter.
- Functions of myelin sheath.

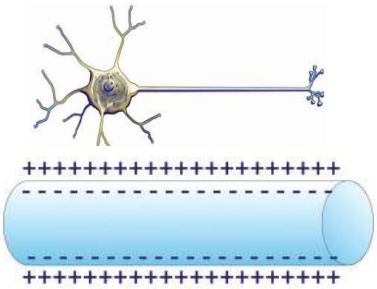


Figure 1.2 a

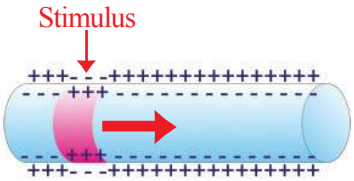


Figure 1.2 b

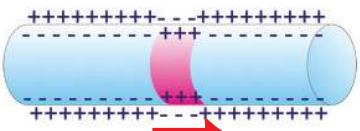


Figure 1.2 c

Generation and Transmission of Impulses

The nervous system manages control and co-ordination through impulses. How are these impulses generated and transmitted through neurons? Analyse the given figures (1.2 a, b, c) on the basis of the description and the indicators, and arrive at your own inferences.

The outer surface of the plasma membrane of the neuron is positively charged and the inner surface is negatively charged. This is due to the difference in the distribution of certain ions (Figure 1.2 a).

When stimulated, the distribution of ions in that particular part changes and hence the inner surface becomes positively charged and the outer surface becomes negatively charged (Figure 1.2 b). This momentary charge difference stimulates its adjacent parts and similar changes occur there too. As this process proceeds, (Figure 1.2 c) impulses get transmitted as electric charges. Nerve impulses are messages transmitted through the neurons.

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Indicators

- Charges on either side of the plasma membrane.
- Change in the charges of ions when stimulated.
- Transmission of nerve impulse.

Synapse

Impulses generated in the receptor cells reach the brain . The brain analyses it and gives direction for proper response. To make this possible, the impulses formed in a neuron are to be transmitted to other neurons and associated cells. How does this become possible? Analyse illustration 1.4 and 1.5 given below, and the description. Prepare a note, based on the indicators and your analysis.

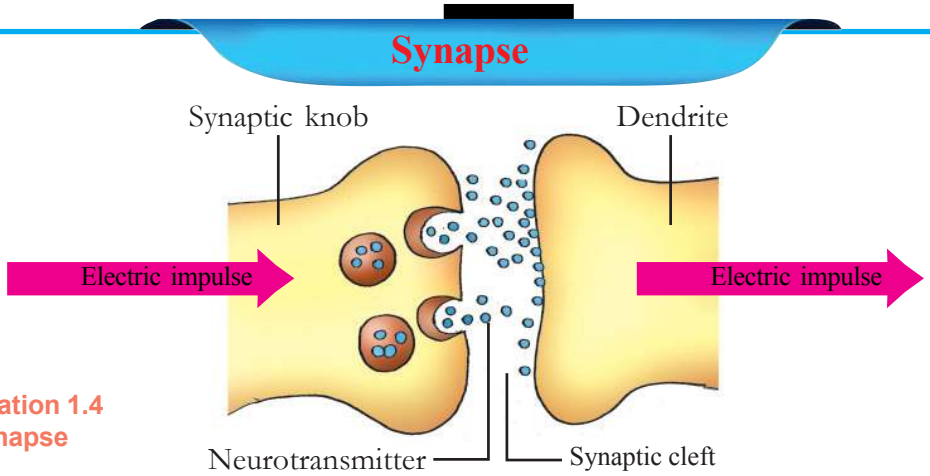

Illustration 1.4
Synapse

Synapse is the junction between two neurons or a neuron and a muscle cell or a neuron and a glandular cell. When electric impulses from the axon reach the synaptic knob, certain chemical substances are secreted from there to the synaptic cleft. These chemical substances are called neurotransmitters. They stimulate the adjacent dendrite or cell and new electric impulses are generated. Acetylcholine and dopamine are examples of neurotransmitters. Synapse helps to regulate the speed and direction of impulses.

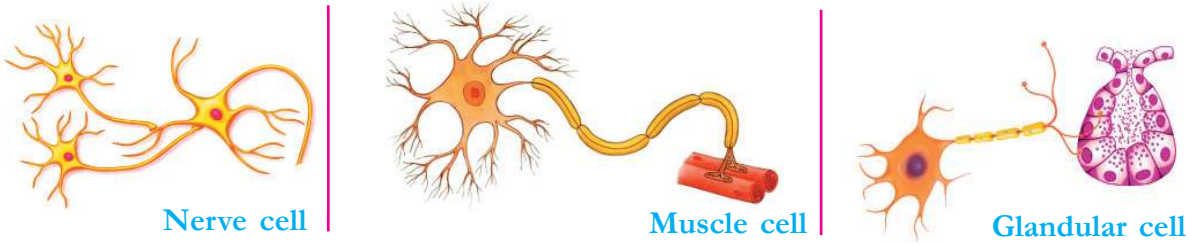

Illustration 1.5 Different types of synapses

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Indicators

- Structure of synapse.
- Transmission of impulses through synapse.
- Significance of neurotransmitter.
- Different types of synapses.

Different types of Neuron

On the basis of the direction of impulse, neurons can be classified into sensory neurons and motor neurons. Sensory neurons carry impulses to the brain and spinal cord. Motor neurons carry impulses from the brain and spinal cord to various parts of the body.

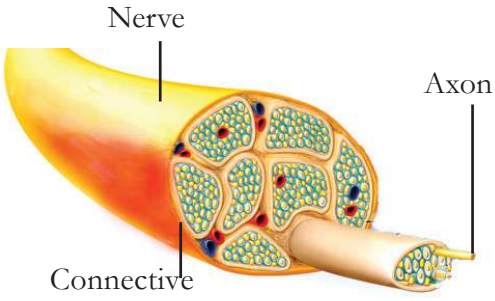


Figure 1.3
Cross section of a nerve

Nerves

You know that nerves are group of axons or nerve fibres. They are covered by connective tissue (Figure 1.3).

Nerves are classified into three on the basis of their functions. Analyse table 1.1 and prepare notes in your Science diary.

Nerves and their peculiarities	Functions
Sensory nerve (formed of sensory nerve fibres)	carries impulses from various parts of the body to the brain and the spinal cord.
Motor nerve (formed of motor nerve fibres)	carries impulses from brain and spinal cord to various parts of the body.
Mixed nerve (formed of sensory nerve fibres and motor nerve fibres)	carries impulses to and from the brain and spinal cord.

Table 1.1 Nerves and their functions

Nervous System

The nervous system consists of two parts, namely the central nervous system and the peripheral nervous system. Analyse illustration 1.6 and complete the flow chart.

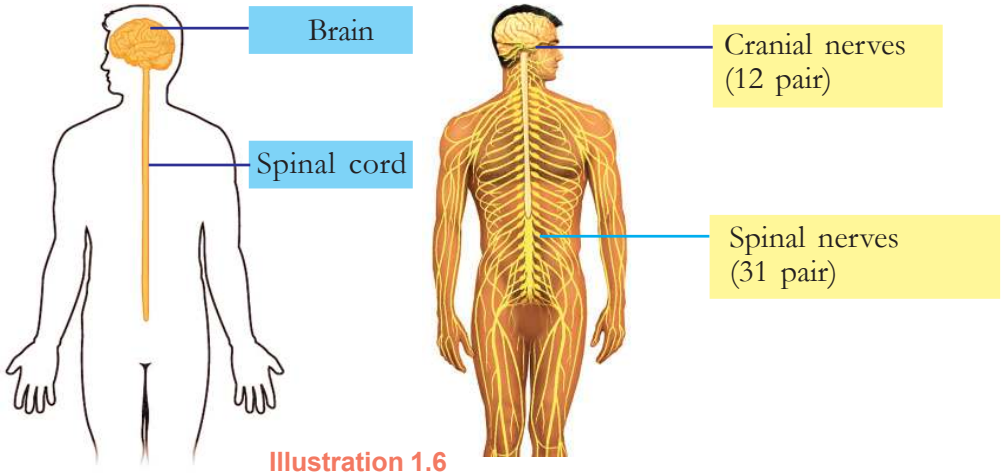
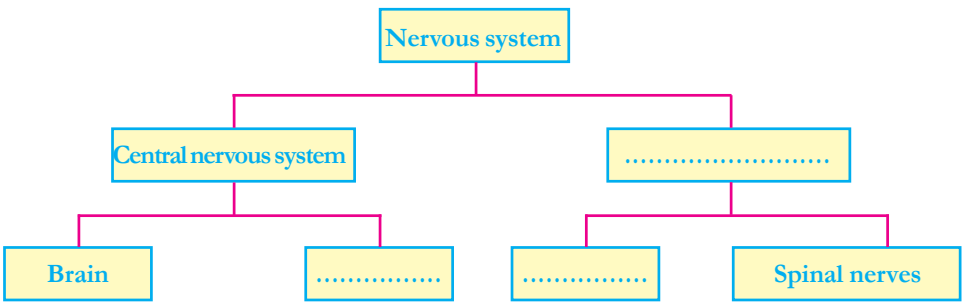


Illustration 1.6

Central nervous system Peripheral nervous system



Brain

Brain is the central part of the nervous system. Based on the indicators, analyse figure 1.4 and the description, understand how the brain gets nutrition and protection. Make notes in your Science diary.

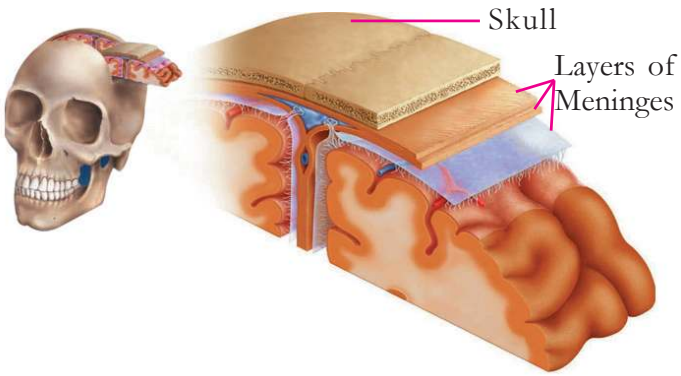


Figure 1.4
Meninges

The brain is protected inside the skull. It is covered by the meninges, a three-layered membrane. The cerebrospinal fluid is filled within the inner membranes of meninges and the ventricles of the brain.

The cerebrospinal fluid formed from the blood is reabsorbed into the blood. The functions of the cerebrospinal fluid are to provide nutrients and oxygen to the tissues of the brain, regulate the pressure inside the brain and to protect the brain from injuries.

Indicators

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- Protection of the brain.
- Nourishment of the brain.

The different parts of the brain control and coordinate all life activities. Analyse illustration 1.7 showing the structure of the brain and list the characteristics and functions of each part.

Cerebrum

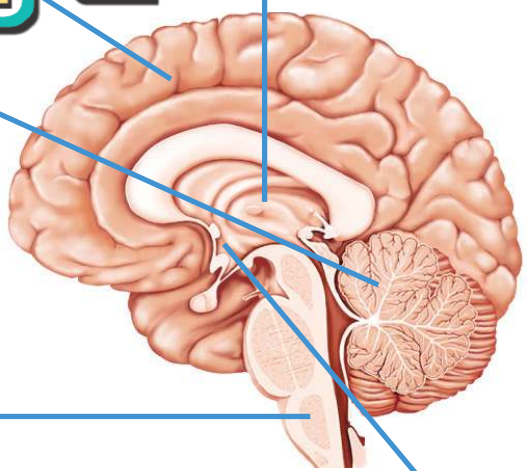
- the largest part of the brain.
- numerous fissures and folds are seen.
- The grey coloured outer part of cerebrum is called Cortex and the white coloured inner part is called Medulla.
- centre of thought, intelligence, memory and imagination.
- evokes sensations.
- controls voluntary movements.

Thalamus

- situated below the cerebrum.
- acts as relay station of impulses to and from the cerebrum.
- analyses impulses from various parts of the body and sends the important ones to the cerebrum.

Cerebellum

- the second largest part of the brain.
- seen behind the cerebrum as two flaps.
- fissures and grooves are present.
- coordinates muscular activities and maintains equilibrium of the body.



Medulla oblongata

- the rod shaped medulla oblongata is seen below the cerebrum, located near the cerebellum.
- controls involuntary actions like heart beat, breathing etc.

Hypothalamus

- situated just below the thalamus.
- plays a major role in the maintenance of homeostasis.

Illustration 1.7 Structure and function of the brain

Aren't you convinced of the importance of the brain? Discuss the necessity of wearing helmets while riding two wheelers.

Spinal Cord

The spinal cord is the continuation of the medulla oblongata. On the basis of the indicators, analyse illustration 1.8 and the description and prepare notes in your Science diary.

The spinal cord is protected inside the vertebral column. Like the brain, the spinal cord is also covered by meninges. The central canal seen in the centre of the spinal cord is also filled with cerebrospinal fluid. In the spinal cord, white matter is seen outside and grey matter is seen inside.

The Spinal Cord within the Vertebral Column

The spinal cord of a new born baby extends upto the tip of the vertebral column. But in adults, it is seen only upto the middle of the vertebral column. This is because the spinal cord does not grow in proportion to the growth of the vertebral column.

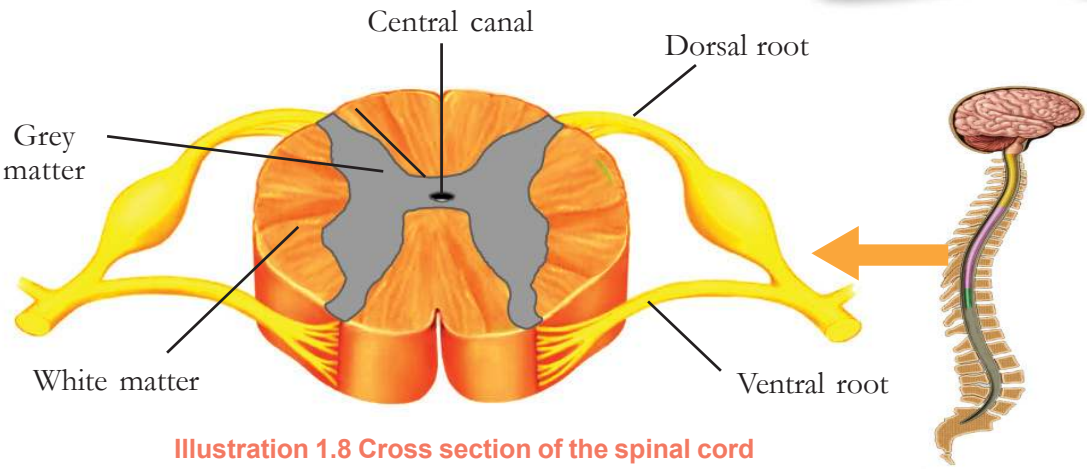


Illustration 1.8 Cross section of the spinal cord

There are 31 pairs of spinal nerves arising from the spinal cord. A dorsal root and a ventral root join to form a spinal nerve. Sensory impulses reach the spinal cord through the dorsal root. Motor impulses go out of the spinal cord through the ventral root. Impulses from different parts of the body are transmitted to and from the brain through the spinal cord. It also coordinates the repeated movements during walking, running etc.

Indicators

- Protection of the spinal cord.
- Formation of the spinal nerves.
- Functions of the spinal cord.

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Figure 1.5 Different responses

Observe figure 1.5. What is the peculiarity of such responses? Analyse the description given below and note down the peculiarities.

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The accidental and involuntary responses towards stimuli are called reflex actions. They do not happen consciously.

How does reflex action happen in our body? Analyse illustration 1.9 and the description and complete the flow chart.

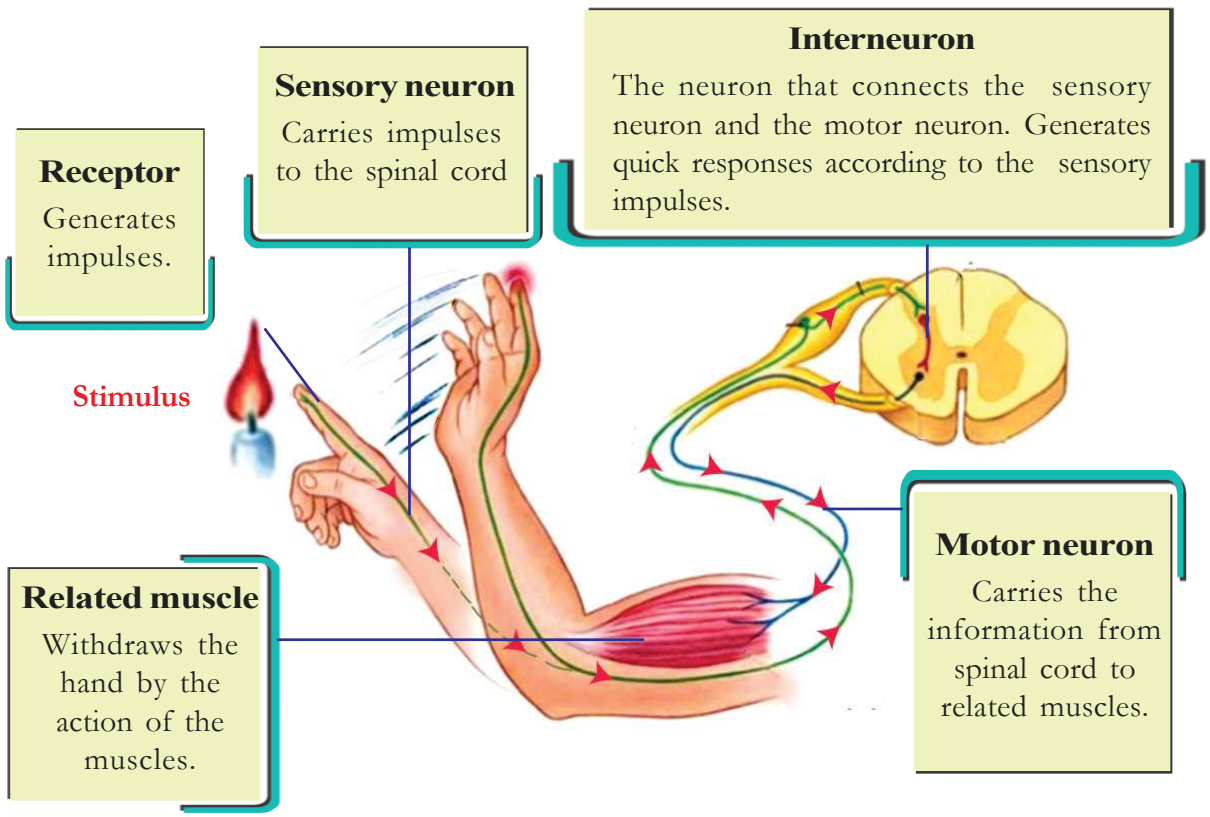
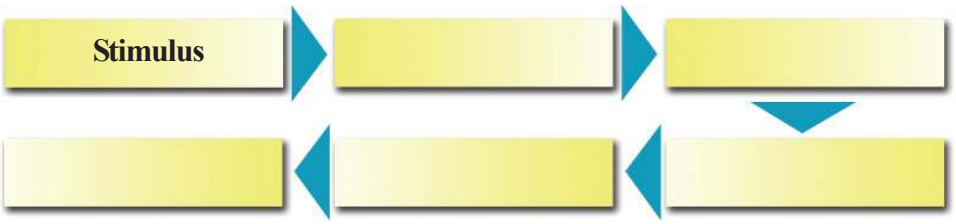


Illustration 1.9
The pathway of impulses in a reflex action



Reflex arc is the pathway of impulses in the reflex action. Mainly spinal cord acts as the centre of reflex action and such reflexes are called spinal reflexes. But all reflexes are not under the control of the spinal cord. Don't we blink our eyes when light suddenly falls on our eyes or when objects move towards them? This is also a reflex action. Such reflexes under the control of the cerebrum are called cerebral reflexes.

Alcohol and Reflex

Alcohol accelerates the action of gama amino butyric acid (GABA), a neurotransmitter in the brain. Higher doses of this neurotransmitter retard the brain action which in turn weakens the reflex action and prevents making proper decision at proper time.

Is it advisable to lift up people quickly by holding their arms or legs in an accident. What aspects related to spinal cord are to be taken care of while attending injured persons? Discuss.

Autonomous Nervous System

There may be instances in your life when you felt sudden fear or sadness. Write down some of those experiences.

- seeing a snake suddenly
-
-

What are the changes that take place in the body during such emergency situations? List them.

- Heart beat increases
-
-
-

Shouldn't these changes return to normal state? Discuss.

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Activities that take place beyond the conscious level are controlled by the autonomous nervous system, a part of the peripheral nervous system. The sympathetic system and the parasympathetic system together form the autonomous nervous system. Analyse illustration 1.10 to understand the actions of sympathetic and parasympathetic systems during emergency situations and complete table 1.2.

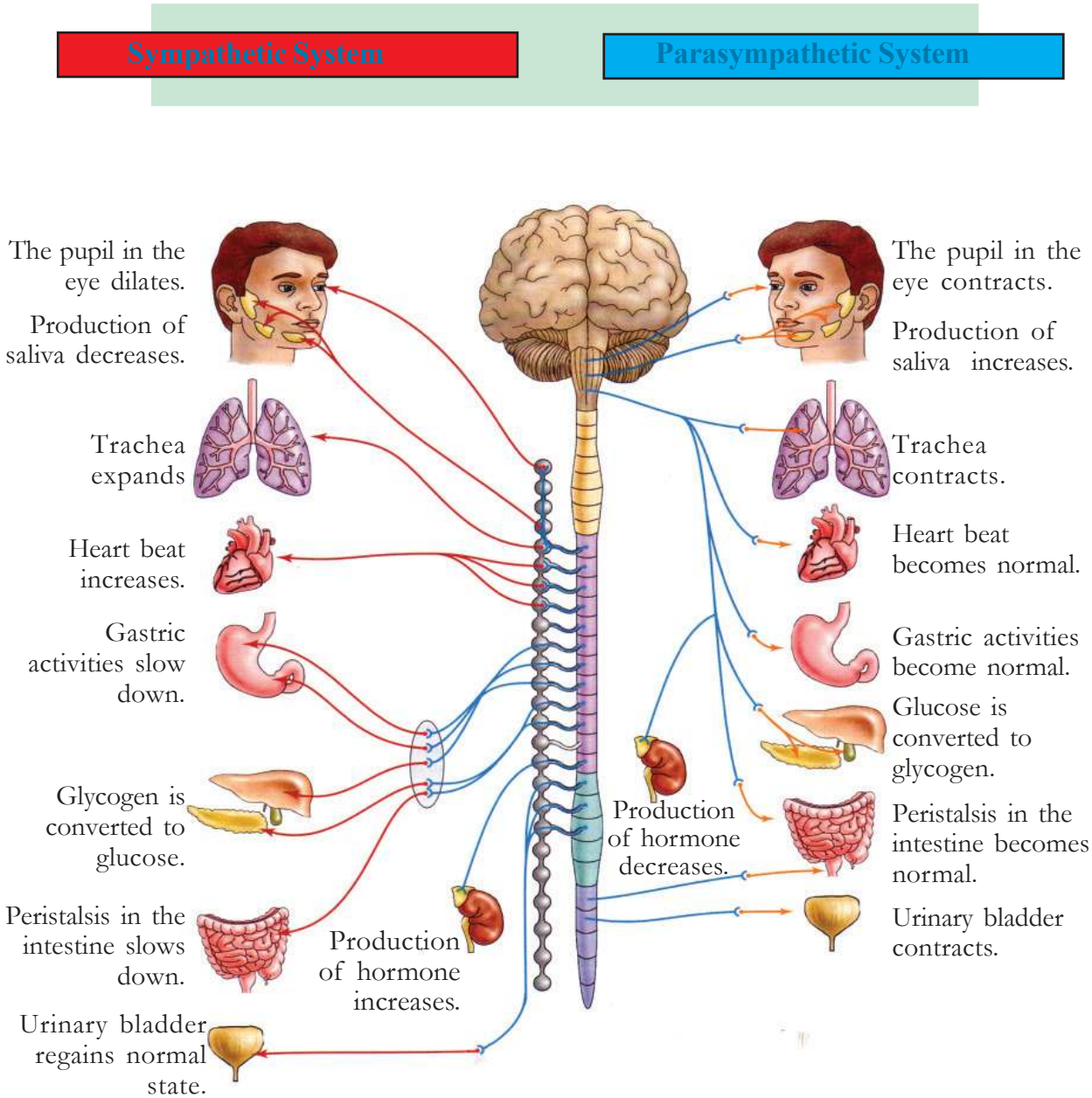

Illustration 1.10 Autonomous nervous system

Organ/part	Action of Sympathetic System	Action of Parasympathetic System
Pupil		
Salivary gland		
Trachea		
Heart		
Stomach		
Liver		
Intestine		
Urinary bladder		

Table 1.2 Action of sympathetic and parasympathetic systems

Nervous System and its Disorders

A healthy nervous system is the basis of normal body activities. Even minor defects in the nervous system may cause serious health problems. List out the familiar diseases that affect the nervous system.

- Rabies
-
-

Conduct a seminar on 'The diseases affecting the nervous system' by analysing table 1.3 and collecting more information on it.

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Disease	Causes	Symptoms
Alzheimer's	Accumulation of an insoluble protein in the neural tissues of the brain. Neurons get destroyed.	Loss of memory, inability to recognize friends and relatives, inability to do routine works.
Parkinsons	Destruction of specialised ganglions in the brain. Production of dopamine, a neurotransmitter in the brain gets reduced.	Loss of body balance, irregular movement of muscles, shivering of the body, profuse salivation.
Epilepsy	Continuous and irregular flow of electric charges in the brain.	Epilepsy due to continuous muscular contraction, frothy discharge from the mouth, clenching of the teeth following which the patient falls unconscious.

Table 1.3 Certain diseases affecting the nervous system

What should be our approach towards people affected by such diseases? Discuss.

The nervous system helps us to experience various stimuli as well as to respond towards them. Special care should be taken to maintain the health of this organ system.

Receptors that receive stimuli promote the actions of nervous system. It would be very interesting to know about these receptors and the sense organs in which they are included.

Let us Assess

1. The part of the brain which helps to maintain balance of the body.

   a) Cerebrum b) Cerebellum

   c) Medulla oblongata d) Thalamus

2. Identify the relation and fill in the blank.

   Irregular flow of charge in the brain : Epilepsy

   Decrease in the production of dopamine : ----------

3. Analyse the following situations and answer the questions.

   - a thorn pierces the foot.
   - the leg is withdrawn.
   - the thorn is taken out slowly.

   a) Write the stimuli and responses.

   b) Was the leg withdrawn after sensing the pain? Identify the reflex action. Prepare an illustration showing the parts through which the impulses were transmitted.

Extended Activities

- Construct a model of the human brain using suitable scrap materials and exhibit it in the class.
- Prepare the script of a short play which contains the methods of first aid to be given to people who have met with accidents and present it.

2 Windows of Knowledge

Earthquake victims rescued

Katmantu : Rescued victims who got trapped in the collapsed buildings due to earthquake in the eastern regions of Katmantu, the Capital of Nepal. The rescue operation was difficult due to heavy rain and insufficient light. Specially trained dogs helped to detect the victims and save their lives during the crisis.

Did you notice the news?

Why are dogs more capable than human beings in tracking the injured in such circumstances? Discuss.

The number of receptors in the sense organs is different in different organisms. The surface of a postage stamp is enough to arrange all the olfactory cells in the nose of a human being. But a large scarf is required to arrange the olfactory cells of a dog.

Now, you might have understood that the number of receptors influence the efficiency of sense organs. There are different types of receptors in our sense organs to receive stimuli.

Expand the given table by adding sense organs and their receptors.

Sense organs	Receptor	Stimulus
• Eye		
• Ear		
• Tongue		
• Skin		
• Nose	Olfactory receptor	Smell

Table 2.1 Sense organs and receptors

Eye

Eye is the major sense organ that helps the brain to evoke sensation. How are the eyes protected? Discuss and fill in the blanks.

- Eye socket : depressions in the skull
- External eye muscles : fix the eye balls in the orbit
- Eyebrow : .....
- Eyelashes : .....
- Eyelids : .....
- Conjunctiva : secretes mucus which protects the anterior portion of the eye ball from being dry.
- Tears : clean and lubricate the anterior part of the eye ball. Lysozyme, the enzyme present in tears, destroys germs that enter the eyes.

How far is the structure of an eye adapted to perform its function? Observe figure 2.1 and illustration 2.1. On the basis of the indicators, write your inferences in the Science diary.

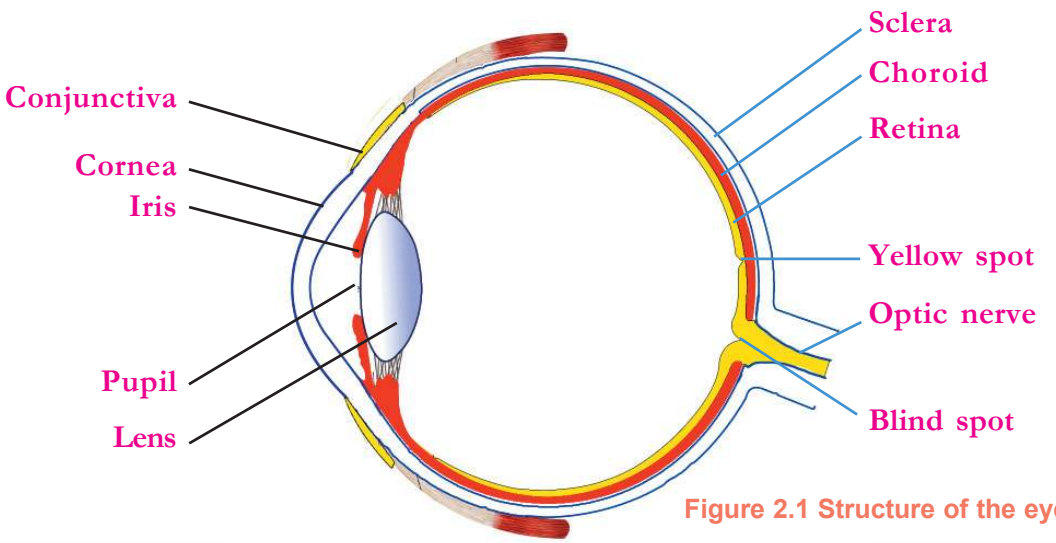

Figure 2.1 Structure of the eye

Layers of the eye

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Sclera

The white outer layer which gives firmness to the eye. Made up of connective tissues.

Cornea

The projected transparent anterior part of the sclera which refracts light rays to focus on the retina.

Conjunctiva

The layer which covers and protects the front part of sclera except the cornea.

Choroid

The middle layer which contains a large number of blood vessels.

Iris

The part of the choroid seen behind the cornea. Presence of the pigment melanin gives the iris a dark colour.

Pupil

The aperture seen at the centre of the iris. The size of this aperture increases and decreases depending on the intensity of light.

Retina

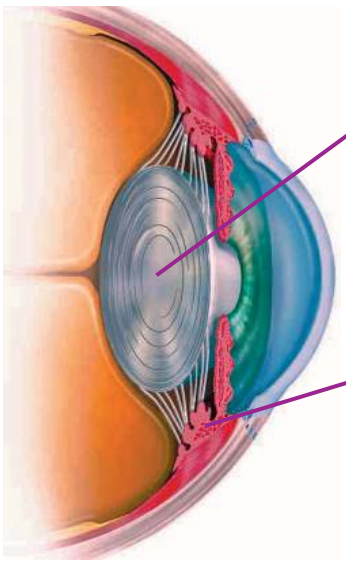
The inner layer which has photoreceptors.

Yellow spot

The part of the retina where plenty of photoreceptors are present. It is the point of maximum visual clarity.

Blind spot

The part of the retina from where the optic nerve begins. Here there is no vision as photoreceptors are absent.



Lens

Elastic transparent convex lens, connected to ciliary muscles by thread like ligaments.

Ciliary muscles

Circular muscles seen around the lens. The contraction and relaxation of these muscles alter the curvature of lens.

Optic nerve

Transmits impulses from photoreceptors to the visual centre in the brain.

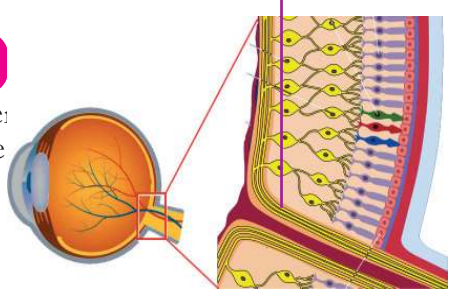


Illustration 2.1 The eye - parts and functions

The fluids in the eye	
Aqueous humor	**Vitreous humor**
The water like fluid filled in the aqueous chamber between the lens and the cornea. It is formed from blood, and is reabsorbed into blood. Provides oxygen and nourishment to the tissues of the eye.	The jelly like substance seen in the vitreous chamber between the retina and the lens. Helps in maintaining the shape of the eye.

Indicators

- Layers of the eye and their function.
- Position and significance of lens and cornea.
- Position of iris and the pupil.
- Location and function of fluids present in the eye.

Regulation of Light in the Eye

The entry of a large amount of light is harmful to the tissues of the eye. Iris and the aperture at its centre called pupil regulate the amount of light falling on the eyes. Analyse figure 2.2 and the description regarding the changes in the pupil in dim light and bright light, and form inferences.

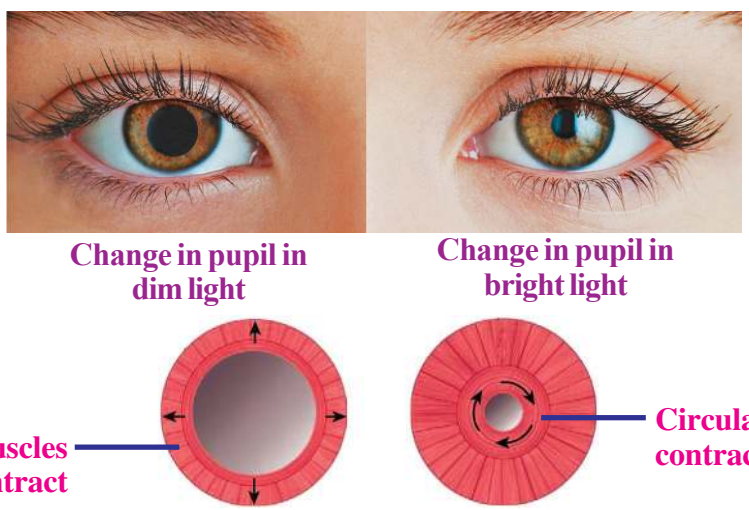


Figure 2.2 Regulation of light in the eye

The size of the pupil is regulated by the action of circular muscles and radial muscles. When the radial muscles contract in dim light, the size of the pupil increases. When the circular muscles contract in intense light, the size of the pupil decreases. Thus the amount of light falling on the lens is regulated according to the intensity of light.