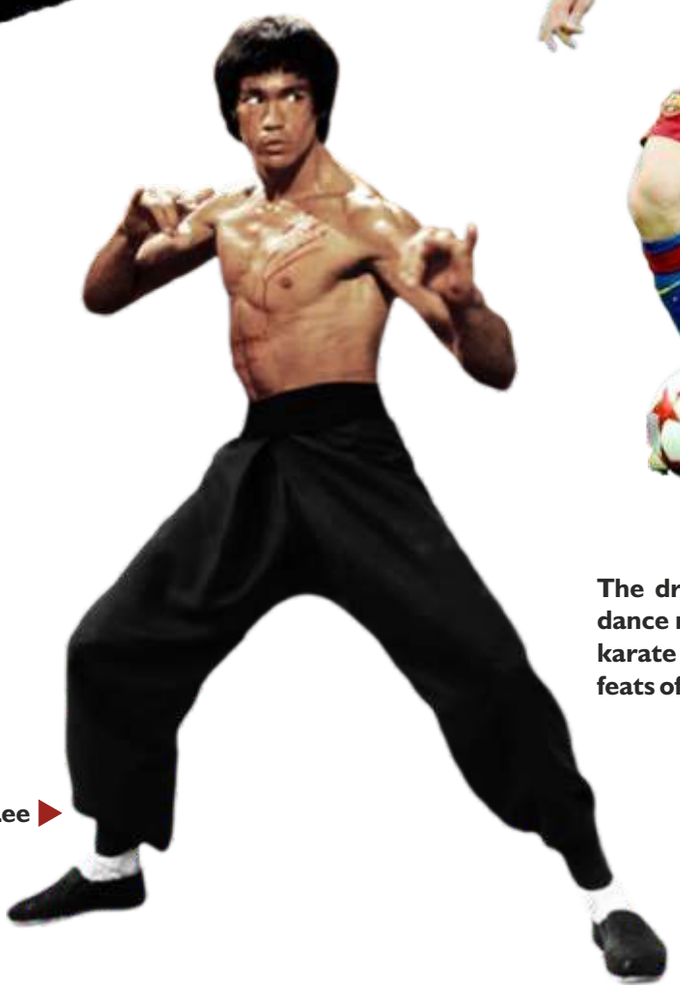
7

CONTROL AND COORDINATION

Michael Jackson

Lionel Messi



Bruce Lee

The dribbling skills of Lionel Messi, the dance moves of Michael Jackson, and the karate kicks of Bruce Lee are stupendous feats of Control and Coordination.

Movement is a response to a change in the environment of the organism. A cat may run to catch a mouse.

A girl playing on a swing is an example for non-growth movement.

An example of a reflex action is when someone steps on a nail. The person immediately withdraws the leg.

INTRODUCTION

Movement is the characteristic property of living organisms. Movement can be of two types: growth related and non-growth related.

The germinating of a seed is an example of a growth related movement. The seedling grows pushing aside the soil and comes out.

Movements like a cat chasing a rat or children playing on the swing or buffaloes chewing cud are all non-growth related movements. These non-growth movements happen as organisms respond to stimuli in the environment.

A cat may run to catch a mouse and children play on the swing for pleasure and fun. Buffaloes chew cud to help break up the food to digest it better. Organisms thus responds to the various stimuli in the environment, creating movement. Plants move towards sunlight. We close our eyes while bright light falls on them. We immediately withdraw our leg if we step on a nail.

Hence it is clear that movement is in response to the environment (various stimuli) and is carefully controlled. Each kind of a change in the environment evokes an appropriate movement in response. When we want to talk to our friends during class, we whisper rather than shout. Clearly, the impending movement depends on the event triggering it. So, such controlled movement must be connected to the recognition of various events in the environment, followed by only the correct movement in response. In other words, living organisms must use systems providing control and coordination.

Control is the ability to regulate the movement (start, slow down, speed up, or stop). Coordination is the working of various organs of an organism in a systematic, controlled, and efficient way to produce proper response to various stimuli.

The control and coordination are managed by two agencies: 1] The Nervous System and 2] Hormonal system.

Animals have the nervous system and the hormonal system to control and coordinate. Plants lack the nervous system but coordinate with their hormonal system.

ANIMALS – NERVOUS SYSTEM

In animals including humans, control and coordination are provided by the nervous system along with the muscular tissues. The nervous system is a complex collection of nerves and specialized cells called **neurons** that transmit signals between different parts of the body. It is essentially the body's electrical wiring.

Neurons are also called nerve cells. They communicate with the body within the body by transmitting electrochemical signals. The electrical signals are also called **nerve impulses** and the chemical signals are called **neurotransmitters**.

Structure of a nerve cell

Neurons look quite different from other cells in the body due to the many long cellular processes that extend from their central **cell body (cyton)**. The **cell body** is the roughly round part of a neuron that contains the nucleus, mitochondria, abundant cytoplasm and most of the cellular organelles.

Small tree-like structures called **dendrites** extend from the cell body to pick up stimuli from the external environment by direct communication with the sensory receptors present in sense organs and from other neurons.

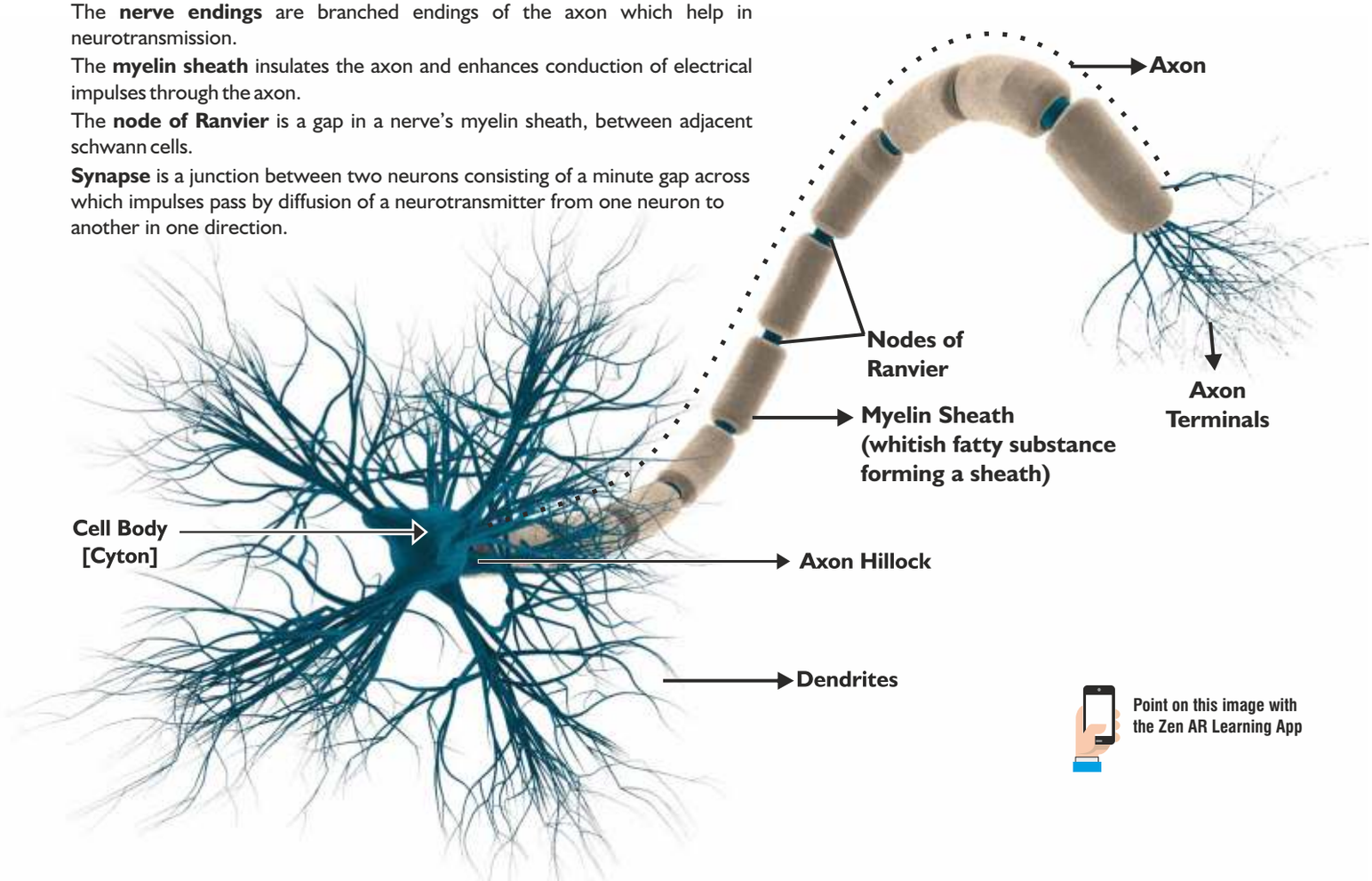
Long transmitting processes called **axons** extend from the cell body to forward signals to other 'like' neurons (effector, motor, and relay) in the body.

The **nerve endings** are branched endings of the axon which help in neurotransmission.

The **myelin sheath** insulates the axon and enhances conduction of electrical impulses through the axon.

The **node of Ranvier** is a gap in a nerve's myelin sheath, between adjacent schwann cells.

Synapse is a junction between two neurons consisting of a minute gap across which impulses pass by diffusion of a neurotransmitter from one neuron to another in one direction.



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There are three basic types of neurons: sensory (afferent) neurons, motor (efferent) neurons, and interneurons.

1] **Afferent neurons:** Also known as **sensory neurons**, afferent neurons transmit sensory signals to the central nervous system from receptors in the body.

2] **Efferent neurons:** Also known as **motor neurons**, efferent neurons transmit signals from the central nervous system to effectors in the body such as muscles and glands.

3] **Interneurons:** Interneurons form complex networks within the central nervous system to integrate the information received from afferent neurons and to direct the function of the body through efferent neurons.

The flow:

Sensory neuron ® interneuron ® relay neuron (brain and spinal cord) ® interneuron ® motor neuron ® interneuron ® effector neuron ® effector muscle ® muscles/glands.

Touching a hot object is an urgent and dangerous situation for us. We need to detect it and respond to it immediately. How do we detect that we are touching a hot object?

All information from our environment is detected by **sensory receptor** cells. These receptors are usually located in our sense organs, such as the inner ear, the nose, the tongue, and so on.

Sensory receptors are generally specialised for the detection of a specific type of stimulus.

Mechanoreceptor: Responds to mechanical stimuli (stress or strain) such as touch and sound. They are found in the hair cells of the cochlea (ear).

Thermoreceptor: Detects temperature changes. The skin of most animals contains these receptors.

Photoreceptor: Responds to changes in light. Examples include those found in the retina.

Chemoreceptor: Detects certain chemical stimuli in the environment. They are found in the nose and on the tongue. E.g.: Gustatory receptors detect taste while olfactory receptors detect smell.

Magnetoreceptor: Allows an organism to sense direction, altitude, or location by detecting a magnetic field.

Touching of hot object → receptor cells (thermoreceptor) → Sensory neuron (afferent neuron) → relay neuron (interneuron) or connector → motor neuron (efferent neuron) → muscles

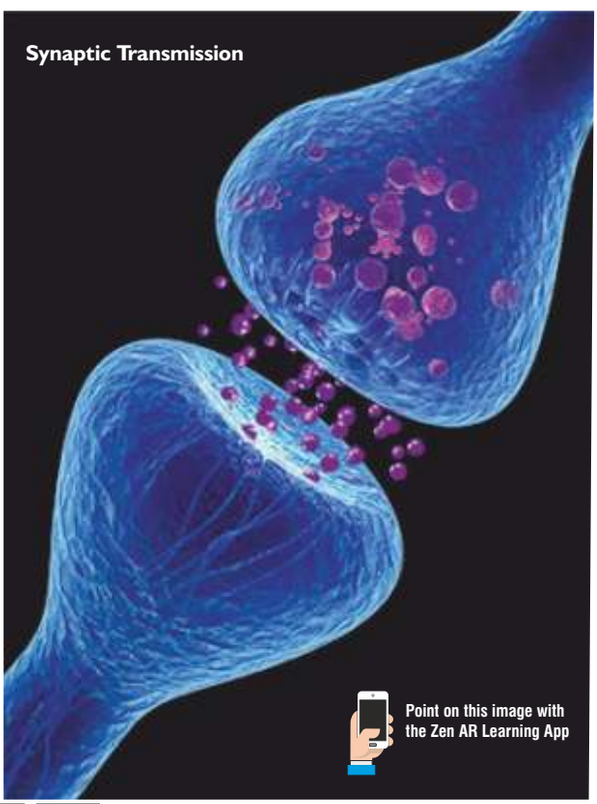
NEUROTRANSMISSION

The sensory receptors directly receive information from the external stimulus and pass this information directly to the end of the dendritic tip of a nerve cell. The cell body (cyton) receives the stimuli (physical, chemical, mechanical, or electrical) from the dendrites and changes it into an electric impulse by a chemical reaction. This impulse travels along the axon to its end. At the end of the axon, the electrical impulse sets off the release of some chemicals. These chemicals cross the gap, or **synapse,** and start a similar electrical impulse in a dendrite of the next neuron. This is a general scheme of how nervous impulses travel in the body.

A similar synapse finally allows delivery of such impulses from neurons to other cells, such as muscle cells or glands.

Synapses are one-way valves. The released chemical (neurotransmitter) is present at only the side of the gap from which the electrical impulse flows. Thus, synapses ensure that a nerve impulse can travel only in one direction through each set of neurons i.e., interneural flow.

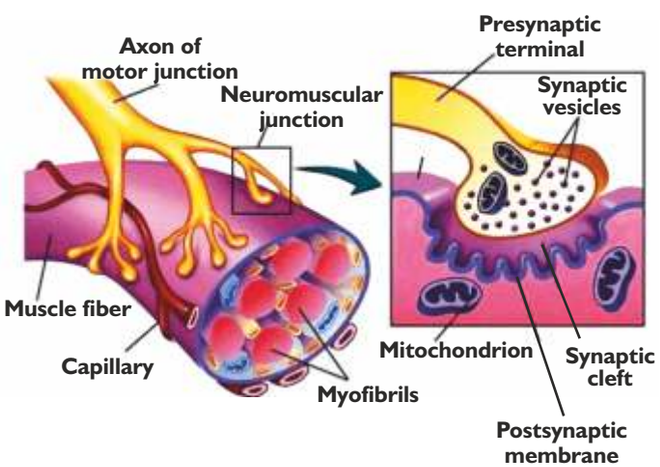
Hence, the nervous tissue is made up of an organised network of nerve cells or neurons, specialised for conducting information via electrical impulses from one part of the body to another.

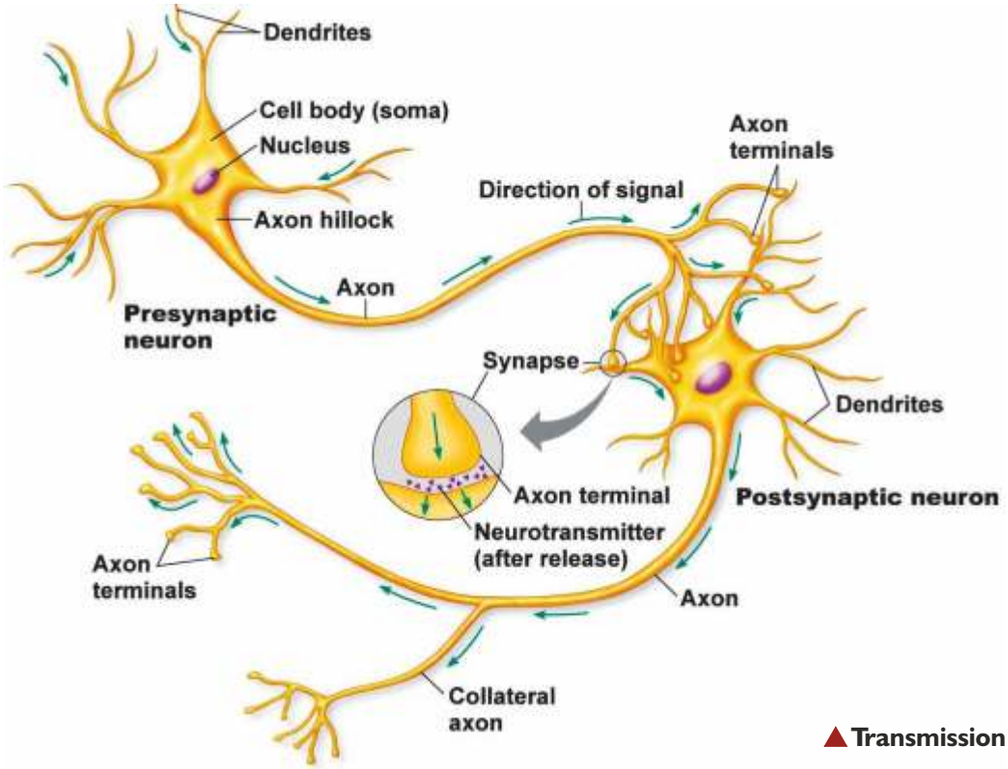


Activity

- Put some sugar in your mouth. How does it taste?
  Sweet
- Block your nose by pressing it between your thumb and index finger. Now eat sugar again. Is there any difference in its taste?
  Yes. It doesn't taste as sweet as before.
- While eating lunch, block your nose in the same way and notice if you can fully appreciate the taste of the food you are eating.
  No. the food wasn't as tempting as it would be when eaten without blocking the nose.
- Is there a difference in how sugar and food taste if your nose is blocked? If so, why might this be happening? Read and talk about possible explanations for these kinds of differences. Do you come across a similar situation when you have a cold?
  Gustatory receptors in tongue detect taste while olfactory receptors in nasal cavity detect smell. Both are chemoreceptors. Hence if one receptor is blocked the effective functioning of the other is affected. If sense of smell is not functional, then the sense of taste will also not function because of the relationship of the receptors.

Neuromuscular Junction





▲ **Transmission of a nerve impulse**

REFLEX ACTION

What happens in reflex actions?
Reflex describes a sudden action in response to something in the environment.

What exactly do we mean?
It is something we do without thinking about it or without controlling our reactions, in response to certain changes in our environment. It is an involuntary and nearly instantaneous movement in response to a stimulus.

How is control and coordination achieved in such situations?
When we touch a hot object without being aware, how do we react?

The hand is pulled away from the object instantaneously.

How does this happen? How long would this take?

Thinking is a complex activity. It involves a complicated interaction of many nerve impulses from many neurons.

The dense network of intricately arranged neurons in the brain receives signals from all over the body. To receive these signals, this thinking part of the brain must be connected to nerves coming from various parts of the body. The brain analyses before responding to these signals. This takes time.

After analysing, the brain sends instructions to the muscles to move. Nerves carry this signal back to relevant parts of the body. By the time all of this happens, we may burn our hand.

If the nerves that detect heat are directly connected to the nerves that move muscles, the signal can trigger an output action quickly without the hand being burnt.

This is more preferred during emergencies.

Reflex actions are sudden, involuntary reactions of the body in response to stimuli. They occur without the involvement of the conscious areas of the brain but the information reaches the brain.

The nerve pathway that includes a sensory nerve and a motor nerve with a synapse in between through which the impulses travel producing a reflex action is called a reflex arc.

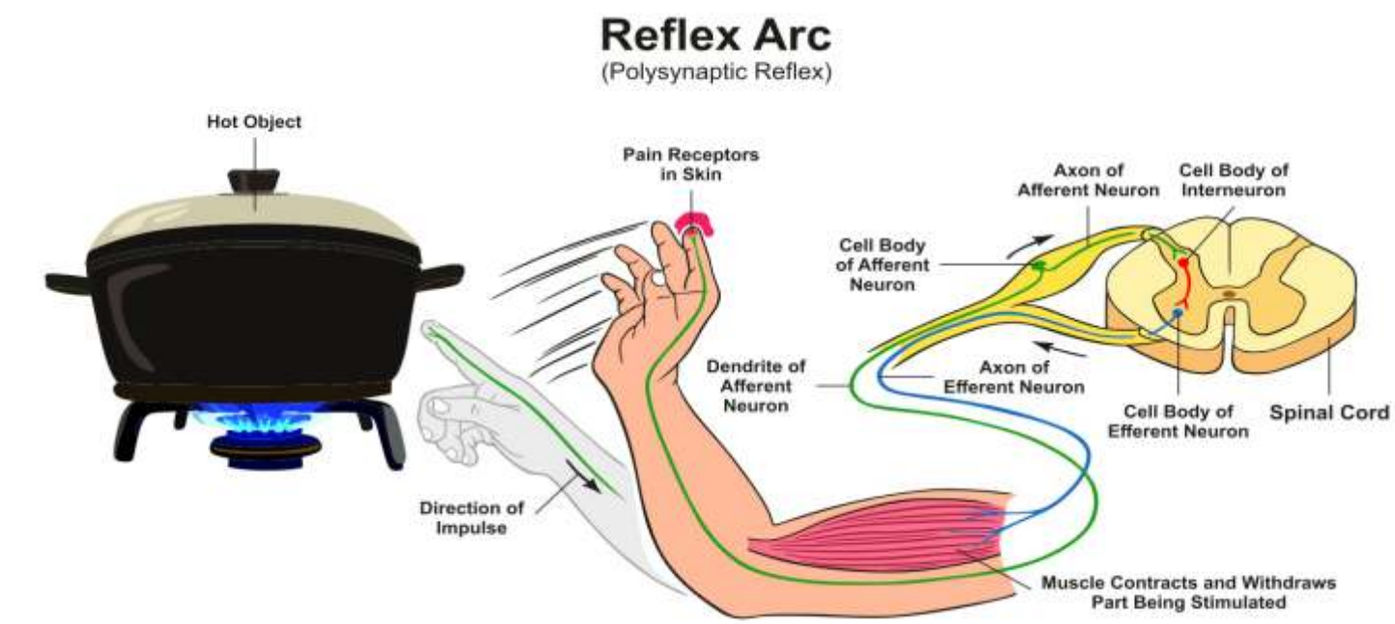
A neurotransmitter is the chemical substance effecting the transfer of an impulse between sensory, motor, and relay neurons.

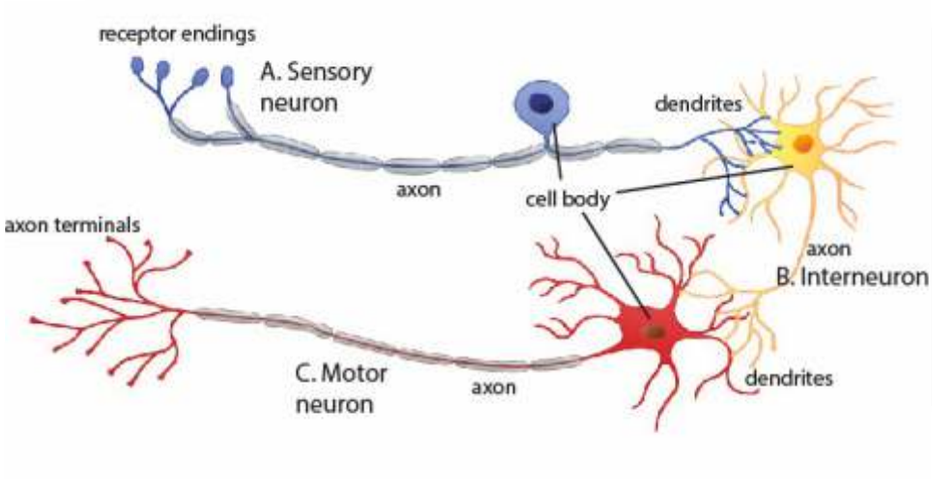
Reflex-arc connections are made at the point where the input and the output nerve first meet each other. Nerves from all over the body meet in a bundle in the spinal cord on their way to the brain. Reflex arcs are formed in the spinal cord itself (**spinal reflex arc**) although the information input also reaches the brain. Reflex arcs have evolved in animals because the thinking process of the brain is slow. In fact, many animals have very little or none of the complex neuron network needed for thinking. So it is quite likely that reflex arcs have evolved as efficient ways of functioning in the absence of true thought-processes. However, even after complex neuron networks have come into existence, reflex arcs continue to be more efficient for quicker responses.

Can you now trace the sequence of events which occur when a bright light is focused on your eyes?

The sensory receptors in the eye receive information from the external stimulus (light) and directly pass this information to the end of the dendritic tip.

This sets off a chemical reaction that creates an electrical impulse. This impulse travels from the dendrite to the cell body, and then along the axon to its end. At the end of the axon, the electrical impulse sets off the release of some chemicals. These chemicals cross the gap, or synapse, and start a similar electrical impulse in a dendrite of an interneuron. The information from the interneuron is transmitted to the motor neuron by a relay neuron. Motor neuron triggers an action in the eye muscles thus resulting in eye closure. This is a **cerebral reflex action** because it involves the brain to which the eyes are connected.





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HUMAN BRAIN

Is reflex action the only function of the nervous system? Definitely not.

Contrary to reflex actions (involuntary), we also think about our actions (voluntary). Writing, talking, and moving a chair are examples of voluntary actions based on deciding what to do next. So, the brain also has to send messages to muscles. This is the second way in which the nervous system communicates with the muscles.

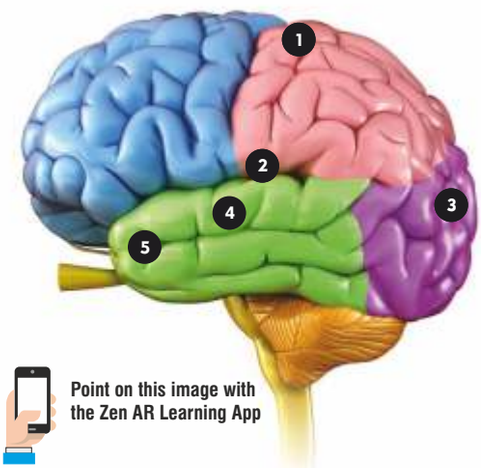
Thinking involves more complex mechanisms and neural connections. These are concentrated in the brain, the main coordinating centre of the body. The **brain** and **spinal cord** constitute the **central nervous system.**

They receive information from all parts of the body and integrate it. The brain thus allows us to think and take actions based on that thinking.

The **peripheral nervous system** facilitates the communication between the central nervous system and the other parts of the body. It consists of cranial nerves arising from the brain and spinal nerves arising from the spinal cord. There are 12 pairs of cranial nerves that directly connect the different regions of the head to the brain. The spinal nerves (31 pairs) connect the different body-parts (skin, muscles) to the spinal cord. The **visceral nerves** connect the internal organs (in the main cavities of the body, especially abdominal; the intestines, for example) to the spinal cord, though same also connect to the brain.

Spinal cord is made up of nerves which supply information to the brain think about.

Thinking is accomplished through a complex design, with different parts of the brain responsible for integrating different inputs and outputs.



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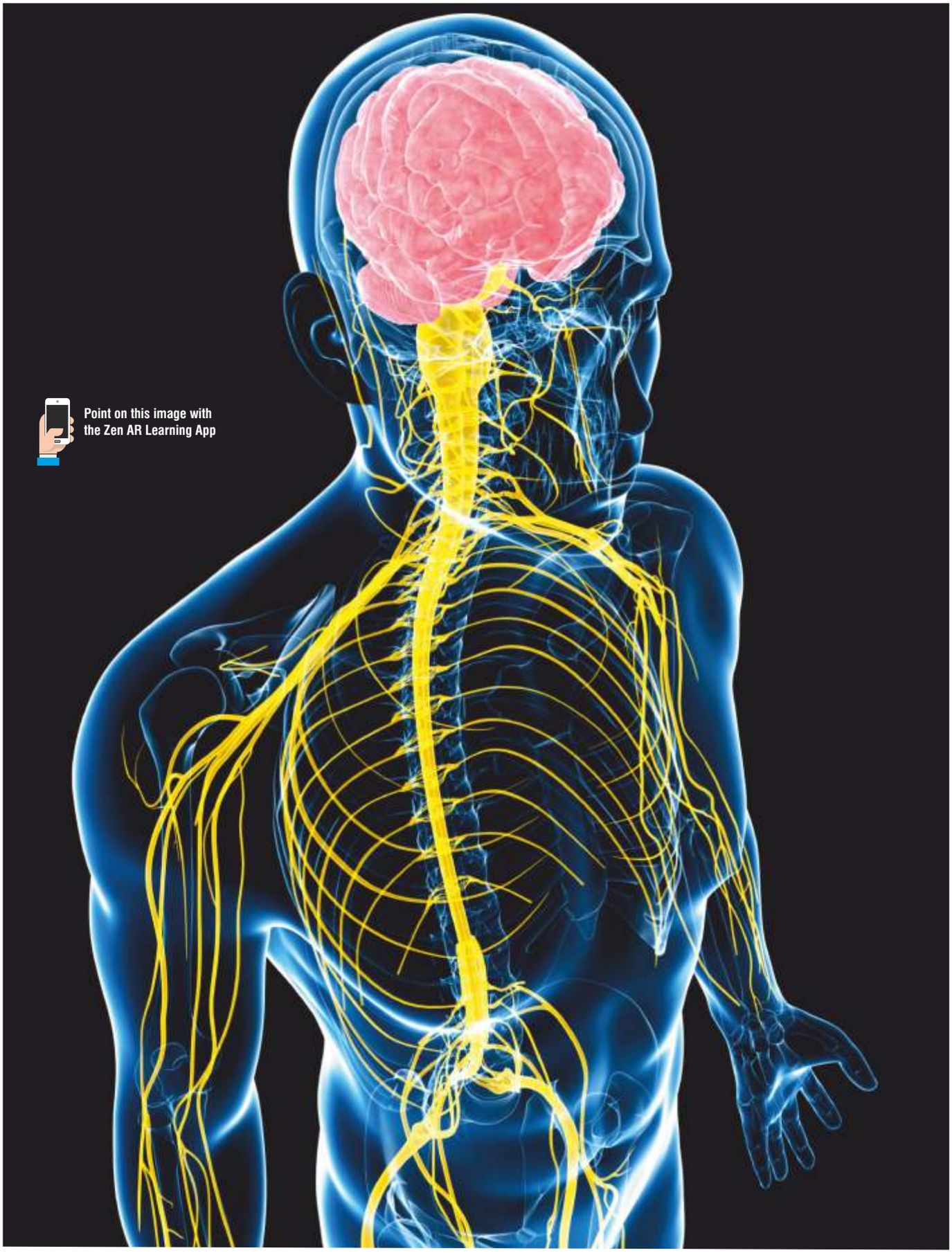
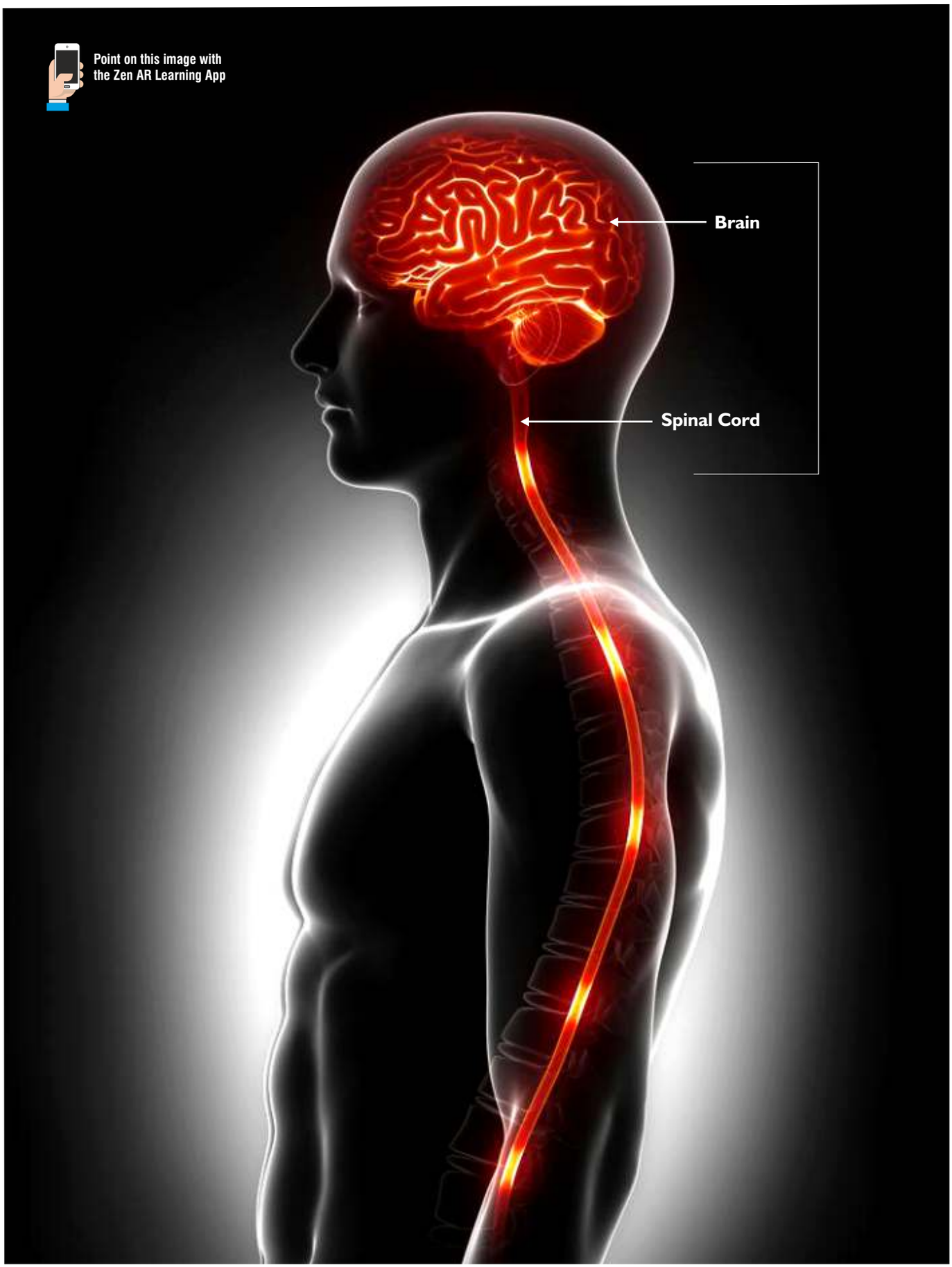
▲ **Sensory areas of the brain**

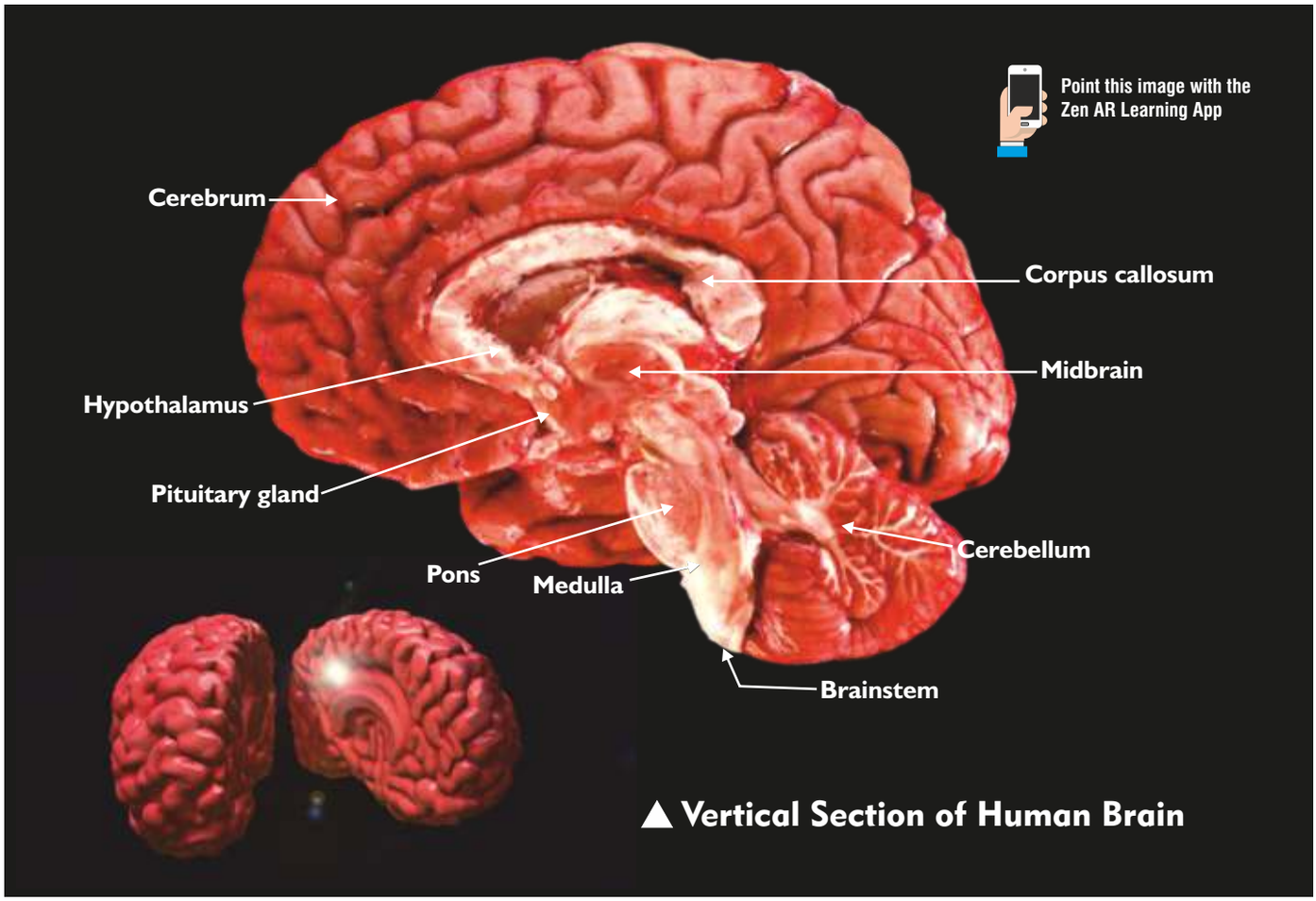
1 **Touch** 2 **Taste** 3 **Vision**
4 **Hearing** 5 **Smell**



▲ **All the nerves in the body that lie outside the brain and spinal cord are Peripheral Nervous System. They carry both sensory and motor neurons.**



▲ The brain and spinal cord constitute the central nervous system



▲ Vertical Section of Human Brain

The brain is covered by three membranes. The membranes are called meninges; space between the brain and cranium is filled with cerebrospinal fluid to protect the brain from mechanical shocks.
The brain has three parts or regions, namely the forebrain (cerebrum), midbrain, and hindbrain.

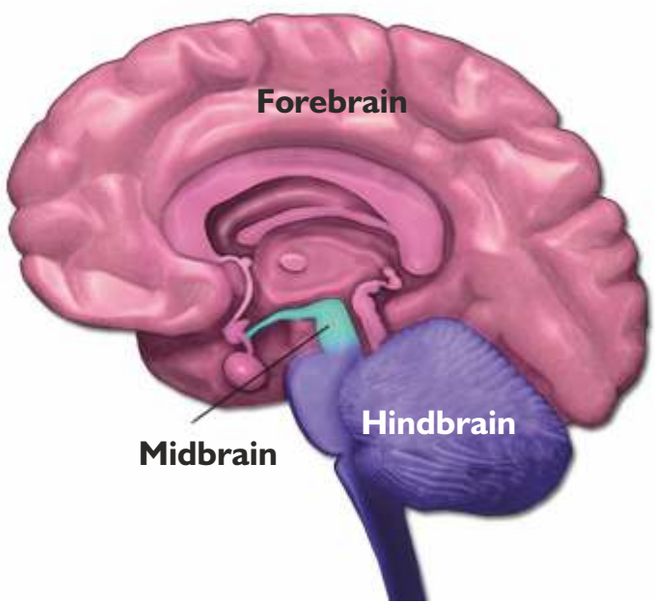
Forebrain

The forebrain is the largest part of the brain and is the main thinker. It includes-

I] **Cerebrum:** It is composed of two cerebral hemispheres-right and left cerebral hemisphere. This is joined together by heavy, dense bands of fiber called the corpus callosum. Each cerebral hemisphere is highly convoluted by sulci and gyri. The sulci (or fissures) are the grooves and the gyri are the "bumps" that can be seen on the surface of the brain. The folding created by the sulci and gyri increases the surface area of cerebral cortex that can fit in the skull. It is further divided into 4 lobes-

- **a] Frontal lobe**: It is associated with parts of speech, planning, reasoning, problem- solving and movements.
- **b] Parietal lobe**: Help in movements, the perception of stimuli and orientation.
- **c] Occipital lobe**: It is related to visual processing.
- **d] Temporal lobe**: This region is related to perception and recognition of memory, auditory stimuli, and speech.

ii] The **thalamus** is a small structure, located right above the brain stem responsible for relaying sensory information from the sense organs and also for transmitting motor information for movement and coordination. It regulates emotions, recognizes sensory impulses of heat, cold, pain, light and pressure.



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iii] **Hypothalamus**- The hypothalamus is a small and essential part of the brain, located precisely below the thalamus. It controls body temperature, sleep and emotional activities, regulates the secretion of pituitary glands.

Midbrain

The **midbrain** connects the forebrain to the hindbrain and regulates movement. It aids in the processing of auditory and visual information.

Hindbrain

It consists of three parts-

I) Cerebellum- second largest part of the brain. It coordinates voluntary movements and maintains equilibrium of the body, posture maintenance.

ii) Pons- A component of brain stem, it connects the cerebrum with the medulla oblongata and cerebellum. It contains nerve bands which joins the two lateral lobes of cerebellum.

iii) Medulla oblongata-it forms the posterior part of the brain and is also called as brain stem. It controls involuntary actions like heartbeat, breathing movements, swallowing and secretion of salivary juice.

How are these tissues protected?

A delicate organ like the brain, so important for a variety of activities, needs to be carefully protected. For this, the body is designed so that the brain sits inside a bony box called a cranium. Inside the box, the brain is contained in a fluid-filled balloon which provides further shock absorption. This fluid is the cerebrospinal fluid.

If you run your hand down the middle of your back, you feel a hard, bumpy structure. This is the vertebral column or backbone which protects the spinal cord.

How does the nervous tissue cause action?

The nervous tissue collects information from receptors and the peripheral nervous system, processes the information, makes decisions based on the information processed, and conveys decisions to muscles for action. So, when an action or movement is to be performed, muscle tissue does the final job.

How do animal muscles move in response to stimulus? When a nerve impulse reaches the muscle, the muscle fibre must move. How does a muscle cell move? Movement of muscles takes place at the cellular level such that the muscle cells move by changing their shape so as to shorten. So, how do muscle cells change their shape?

The answer lies in the chemistry of cellular components. Muscle cells have special proteins (myosin and actin) that change both their shape and their arrangement in the cell in response to nervous electrical impulses. When this happens, new arrangements of these proteins give the muscle cells a shorter form.

When we talked about muscle tissue in Class IX, we spoke on voluntary muscles and involuntary muscles. Based on what we have discussed so far, what do you think the differences between them would be?

The voluntary muscles can be moved voluntarily with thinking or involuntarily during reflex actions. They contract faster. The movements in the involuntary muscles are controlled by medulla. Contractions in involuntary muscles are relatively slow and not powerful.

COORDINATION IN PLANTS

You see plants all around you. But, are they of the same size or height? Of course not! You see big trees, medium-sized shrubs, and even plant saplings. This tells us that plants exhibit some growth changes and some movements.

Animals have a nervous system and an endocrine system for controlling and coordinating the activities of the body. But plants have neither a nervous system nor muscles. So, how do they respond to stimuli?

What is coordination in plants?

Coordination is the ability to use different parts of the plant together, smoothly and efficiently. In plants, coordination is due to the presence of a chemical system, wherein plant hormones or phytohormones have a major role.

MOVEMENT IN PLANTS

Plants exhibit two types of movements.

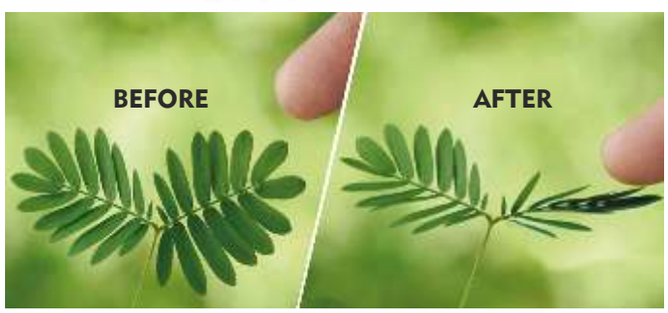
1] Growth-dependent movements called the tropic movements (towards or away from a stimuli)

2] Non-growth movements called the nastic movements (independent of the direction of stimuli)

Nastic movements

Nastic movements in plants are not directional movements. They are not dependent on the direction of stimuli and are growth independent. For example, the leaves of a touch-me-not plant (*Mimosa Pudica*) fold up and droop immediately when touched. There is no nervous tissue nor any muscle tissue. How does the plant detect the touch and how do the leaves move in response? At the base of a leaf, a flat structure called pulvinus is present. Its cells have abundant water and are hence turgid. In this scenario, pulvinus

Touch-me-not plant (Mimosa Pudica)



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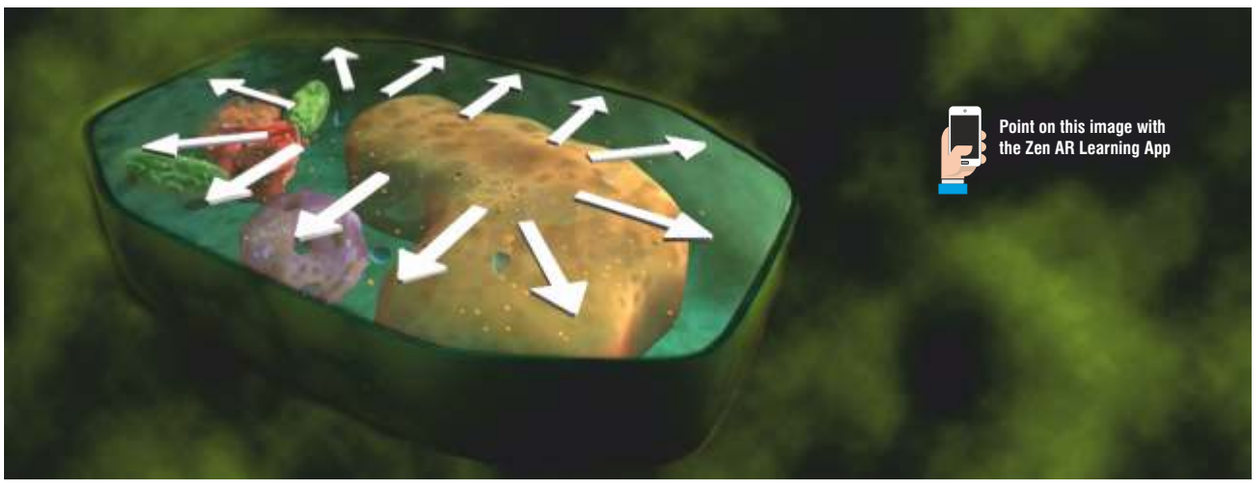
keeps the leaf erect. If a person touches this leaf, an electrical impulse is generated in the ordinary cells of the leaf that acts on a plant harmone causing half of the pulvinus cells to lose water and become flaccid. So the pulvinus loses firmness and the leaf folds up. When water from the intercellular cells reaches the pulvinus cells, the latter become turgid again. The leaf opens again.

The mechanism that makes Mimosa Pudica leaves to close

Water within the cells and other cell contents apply a certain amount of force against the cell walls of the plant; this is called **turgor pressure**. It is due to turgor pressure that the leaves of this plant stay upright unless disturbed externally. Now, when you touch or shake the leaves, the swollen base of the leaf stalk), which contains certain contractile proteins, is activated.

When disturbed externally, certain regions of the plant trigger a release of various chemicals, including potassium ions, within the body of the plant. These chemicals make water and electrolytes flow/diffuse out of the cell, resulting in a loss of cell pressure. This causes the cell to collapse, which squeezes the leaves shut. Stimulus, in the form of touch, is sometimes transmitted to neighbouring leaves too, which causes the leaves to fold up and droop.



TROPIC MOVEMENTS

These can be classified into five types. They are:

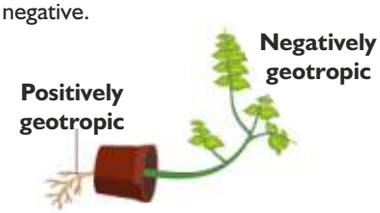
1] Phototropism (light)
2] Geotropism (gravity)
3] Hydrotropism (water)
4] Chemotropism (chemicals)
5] Thigmotropism (touch)

1] Phototropism

It is the movement of plants in response to light. The shoot system of a plant exhibits this characteristic. The shoot moves towards the light. Environmental triggers such as light change the directions that plant parts grow towards. These movements can be either towards the stimulus or away from it. So, in two different kinds of phototropic movement, shoots respond by bending towards light (positive phototropism) while roots respond by bending away from light (negative phototropism).

2] Geotropism

It is the movement of a plant part towards the soil. The roots always move in the direction of the earth's gravity. The roots of a plant always grow downwards while the shoots usually grow upwards and away from the earth. Like phototropism, geotropism can be both positive and negative.

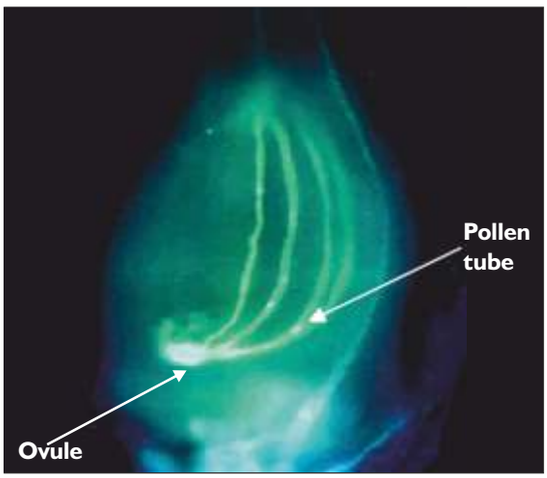


3] Hydrotropism

It is the movement of a plant towards water. The stimulus is water. A positive hydrotropism is one where the organism tends to grow towards moisture whereas a negative hydrotropism is when the organism grows away from it. Positive hydrotropism is the growth of plant roots towards a higher relative humidity level. The growth of the shoot away from water is negative hydrotropism.

4] Chemotropism

It is the movement of plants in response to a chemical stimulus. A classic example of this type of movement is the growth of the pollen tube towards the ovule, during fertilization, in a flower.



▲ **Growth of pollen tube towards the ovule is an example for chemotropism.**

5] Thigmotropism

It is a directional movement in plants in response to touch. For e.g., the plant tendrils climb around any support which they touch. Some plants like the pea plant climb up other plants or fences by means of tendrils. These tendrils are sensitive to touch. When they come in contact with any support, the part in contact with the object does not grow as rapidly as the part of the tendril away from the object.

This causes the tendril to circle around the object and thus cling to it. More commonly, plants respond to stimuli slowly by growing in a particular direction. Because this growth is directional, it appears as if the plant is moving.

▲ **In climbers, the plant coils itself around a supporting structure due to thigmotropism.**

Activity

i] Fill a conical flask with water.

ii] Cover the neck of the flask with a wire mesh.

iii] Keep two or three freshly germinated bean seeds on the wire mesh.

iv] Take a cardboard box open from one side.

v] Keep the flask in the box such that the open side of the box faces light coming from a window .

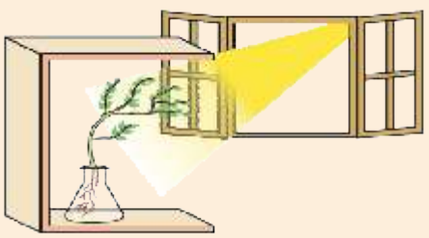
vi] After two or three days, you would notice that the shoots bend towards light and roots away from light.

vii] Now turn the flask so that the shoots are away from light and the roots towards light. Leave it undisturbed in this condition for a few days.

viii] Have the old parts of the shoot and root changed direction?
Yes.

ix] Are there differences in the direction of the new growth?
Yes. The roots are found growing away from the light while the shoot grows towards it.

x] What can we conclude from this activity? Light changes the directions of growth of different plant parts.
Light changes the direction in which the plant parts grow. Hence we can conclude that plant shoot responds to light by by bending towards the direction of light (positively phototropic) while the root grows away from the stimuli (negatively phototropic).



PLANT HARMONES OR PHYTOHORMONES

Let us now once again think about how information is communicated in the bodies of multicellular organisms. The movement of the sensitive plant in response to touch is very quick. The movement of sunflowers in response to day or night, on the other hand, is quite slow.

Growth-related movement of plants are even slower. Even in animal bodies, there are carefully controlled directions of growth. Our arms and fingers grow in certain directions, not haphazardly.

So, controlled movements can be either slow or fast. If fast responses to stimuli are to be made, information transfer must happen very quickly.

Electrical impulses through nerve cells are an excellent means for this. But they have limitations.

i] They reach only those cells connected by nervous tissue.

ii] Once an electrical impulse is generated in a nerve cell and transmitted, the cell takes some time to reset its mechanisms

before it can generate and transmit a new impulse. Thus nerve cells cannot continuously create and transmit electrical impulses.

Thus most multicellular organisms use other means of communication between cells, namely, chemical communication.

i] If, instead of generating an electrical impulse, stimulated cells release a chemical compound, this compound would diffuse all around the source cell. If neighbouring cells detect this compound using special molecules on their surfaces, they would be able to recognise information, and also transmit it.

ii] This, though slower, can potentially reach all cells of the body, regardless of nervous connections, and it can be done steadily and persistently. It would not require any reset time.

These compounds, called hormones, used by multicellular organisms for control and coordination, show a great deal of diversity, as we would expect.

What are hormones?

Hormones are specific molecules produced by the endocrine system in animals that act as messengers to perform important and critical functions of the body. They are directly released by the endocrine glands (without ducts) within the body into the circulatory system and reach the organs or areas of the body that require attention. The word hormone is derived from the Greek word 'to set in motion'.

They regulate specific biological activities including growth, development of the body skeleton and muscles, metabolism, movements, water usage and storage, electrolytic balance, sexual development, and physical appearance.

Both plants and animals produce and secrete hormones to carry out important functions.

PLANT HORMONES

In plants the hormones are called **phytohormones** and endogenous growth inhibitors. A combination of these determines normal growth process in plants.

Different plant hormones help to coordinate growth, development, and responses to the environment. They are synthesized at places away from where they act and simply diffuse to the area of action.

There are different types of hormones which affect the growth of a plant. Phytohormones are chemical compounds released by stimulated cells. These hormones are diffused around the plant cells. They play a in role cell division, cell enlargement, cell differentiation, fruit growth, falling of leaves, ripening of fruits, ageing of plants, etc.

The different types of phytohormones are:

1] Auxins **2] Gibberellins**
3] Cytokinins **4] Abscisic acid**

Auxins

They help in the cell growth at the shoot tips. By elongating the cells, they help in the growth process. Auxin is negatively phototropic and positively geotropic.

Let us take an example that we have worked with earlier. When growing plants detect light, auxin, synthesized and secreted by the meristematic tissue at the shoot tip, helps the cells to grow longer. When light comes from one side of the plant, auxin diffuses towards the shady side of the shoot. This concentration of auxin stimulates the cells to grow longer on the side of the shoot away from light. Thus, the plant appears to bend towards light.

▲ **Auxin distributed uniformly**

▲ **Concentration of auxin in the shady side of the shoot.**

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GIBBERELINS

These hormones promote cell growth in the stem (in the presence of auxin), seed germination, and flowering.

CYTOKININS

They promote cell division in plants. They are present in greater concentration in areas of rapid cell division, such as in fruits and seeds . They also promote the opening of the stomata and delay ageing in leaves.

ABSCISIC ACID

This hormone inhibits the growth of the plant (endogenous growth inhibitor). So it promotes dormancy in seeds and buds. The falling of fruits, flowers, and leaves, etc. are promoted by this hormone.

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HORMONES IN HUMANS

Hormones are chemical substances secreted in very small amounts by specialized tissues in the body called **endocrine glands**. These hormones coordinate the activities of living organisms and also their growth. The various characteristics of hormones are-

- They are secreted in small amount by the glands.
- Hormones are poured directly into the blood and carried throughout the body by blood.
- The hormones have their effect at the sites different from the sites where they are made. So they are also called as **chemical messengers**.
- Hormones act on specific tissues or target organs.
- The hormones coordinate the activities of the body and also its growth.

Glands

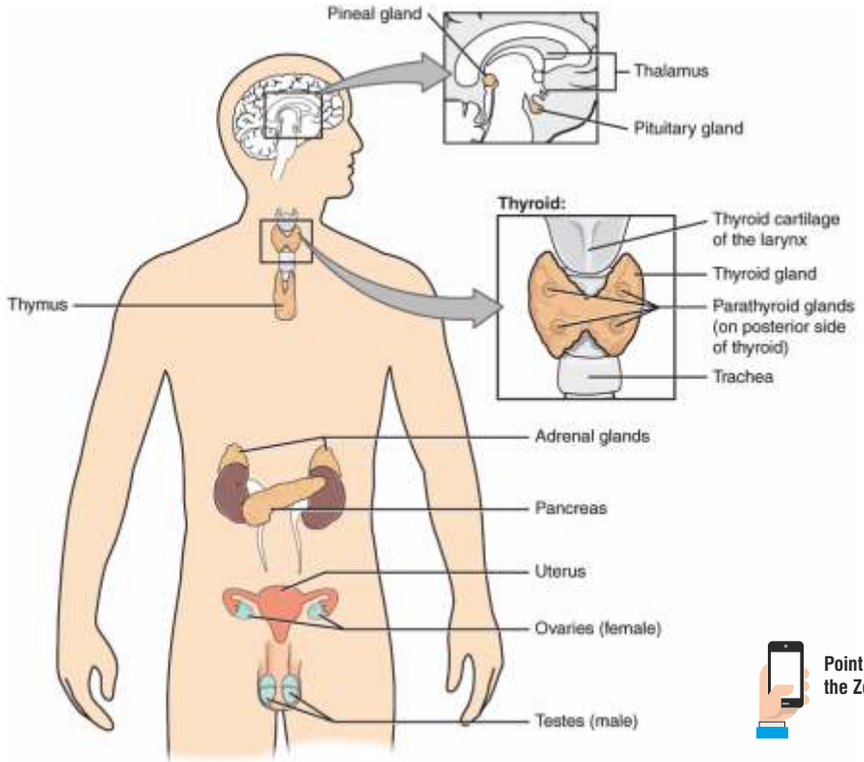
A gland is a structure which secretes a specific substance in the body. A gland is made up of group of cells or tissue. There are two types of glands in the body- **Endocrine glands** and **exocrine glands**. The differences between the two are given below.

Exocrine gland	Endocrine gland
The glands possess ducts	These glands lack ducts
These glands pour their secretions to the target directly	These glands pour their secretions into blood.
Secretions are various enzymes, mucus, excretory substances, lubricants, etc.	Secretion consists of chemical messengers called hormones.
These glands do not occur in isolation	These glands occur in isolation
The target sites are adjacent to the glands	The target sites are far away from the glands

THE ENDOCRINE SYSTEM

A group of endocrine glands which produce various hormones is called **endocrine system** or **hormonal system**. In addition to nervous system, the endocrine system also helps in coordinating the activities of our body. There are various endocrine glands present in human body located at different sites. Their details are given below.

Sl. No.	Name of glands	Location	Hormone secreted	Functions
1.	Pituitary		Growth hormone (GH), Thyroid stimulating hormone (TSH), Gonad stimulating hormone (GSH)	Controls growth, Produces thyroxine and stimulates thyroid gland, Checks the activity of other glands, called as master gland.
2.	Pineal gland	Midbrain region	Melatonin serotonin	Affects reproductive development, Regulates biological rhythms such as sleep - wake cycles and seasonal functions. Regulates blood pressure by decreasing the diameter of blood vessels.
3.	Thyroid	Just below larynx	Thyroxine and calcitonin.	Helps in controlling growth, respiration and metabolism.
4.	Parathyroid	Embedded on dorsal side of thyroid gland	Parathormone	Regulates calcium and phosphate ions in the blood.
5.	Thymus gland	One on either side of trachea.	Thymus hormone/thymosin	Plays a role in the development of the immune system of the body.
6.	Pancreas	Lies below the stomach	Insulin	Controls blood sugar in the body.
7.	Adrenal	Top of each kidney.	Adrenaline (also called gland of emergency)	Regulates heartbeat, breathing rate, blood pressure and carbohydrate metabolism. Helps the body to adjust to stress and strain.
8.	Testes	Located outside the abdominal cavity (inside scrotum)	Testosterone	Develops secondary sexual characters and controls releasing of sperms
9.	Ovaries	Lies in the abdomen.	Estrogen and progesterone	Estrogen-Develops secondary sexual characters and controls release of egg. Progesterone- controls the uterus changes during menstrual cycle and helps in maintaining pregnancy



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▲ **Location of endocrine glands in humans**

Certain the glands in our body act as dual glands (endocrine and exocrine). For example- the **pancreas** gland when acts as endocrine gland secretes the hormone **insulin** while as exocrine gland, it secretes **pancreatic juice** which helps in digestion of food. Similarly, **testes** in males acting as an endocrine gland secrete the hormone **testosterone** but when it acts as an exocrine gland, it releases male gametes - **sperms** in the duct. Similarly, ovaries in females secrete hormones **estrogen and progesterone** while acting as endocrine gland, and release the female gamete – the **ovum** in the duct while acting as an exocrine gland.

The working of endocrine gland is controlled by our nervous system. The hormones produced by endocrine glands act as messengers between the nervous system and organs of our body. The complete coordination is achieved by the nervous system and endocrine system working together. The main centers in the body for the coordination of two systems of control are the **hypothalamus** and the **pituitary** gland.

The hypothalamus plays an important role in collecting information from other regions of the brain and from blood vessels passing through it. This information is passed on to the pituitary gland which by its own secretions directly or indirectly regulates all activities of other endocrine glands.

Hormones when not secreted in balanced amount causes problems like:

1] **Pituitary Gland** – Deficiency of growth hormones in childhood causes **dwarfism** while over – secretion causes **gigantism.**

2] **Thyroid** - Iodine is necessary for making of thyroxine hormone by thyroid gland. Deficiency of iodine in the food causes **goitre.** It is characterized by the swelling and enlargement of neck. It is found mostly in hilly regions due to deficiency of iodine in water. Deficiency of iodine causes the thyroid gland to become hyperactive and enlarged so that it can secrete more thyroxine hormone. Thus, under secretion of thyroxine hormone causes goitre.

Over-secretion of thyroxine is called **hyperthyroidism** and results in change in appetite, sudden weight loss, fatigue, sleep disorder, frequent urination, increased sweating, irregular menstrual cycle, retraction of eyelids (causing a 'staring appearance'), thinning of hair, etc.

Under-secretion of thyroid hormones results in **hypothyroidism** which causes weight gain, poor memory, depression, stiffness of the muscles, fatigue, low heart rate, reduced appetite, reduced fertility, intolerance to cold temperatures, etc.

3] **Pancreas** - Deficiency of insulin causes a condition known as **diabetes**. It is characterized by release of large amount of sugar not only in blood but also in urine. If for some reason it is not secreted in sufficient amount, the level of sugar increases in the blood. It can be controlled by diet, reducing weight, doing regular physical exercise and taking medications. People having severe diabetes are treated by giving injections of insulin.

Dwarfism and gigantism

Goitre caused by deficiency of iodine in food

QUESTIONS SECTION

IN-TEXT QUESTIONS

Page no. 119:

1] What is the difference between a reflex action and walking? [CBSE 2019]

2] What happens at the synapse between two neurons?

3] Which part of the brain maintains posture and equilibrium of the body?

4] How do we detect the smell of an agarbathi [incense stick]?

5] What is the role of the brain in reflex action?

Page no. 122:

1] What are plant hormones?

2] How is the movement of leaves of the sensitive plant different from the movement of a shoot towards light?

3] Give an example of a plant hormone that promotes growth.

4] How do auxins promote the growth of a tendril around a support?

5] Design an experiment to demonstrate hydrotropism.

Page no. 125:

1] How does chemical coordination take place in animals?

2] Why is the use of iodised salt advisable?

3] How does our body respond when adrenaline is secreted into the blood?

4] Why are some patients of diabetes treated by giving injections of insulin?

TEXTUAL EXERCISE

1] Which of the following is a plant hormone?
a] Insulin b] Thyroxin
c] Oestrogen d] Cytokinin.

2] The gap between two neurons is called a
a] dendrite b] synapse
c] axon d] impulse

3] The brain is responsible for
a] thinking b] regulating the heart beat
c] balancing the body d] all of the above

4] What is the function of receptors in our body? Think of situations where receptors do not work properly. What problems are likely to arise?

5] Draw the structure of a neuron and explain its function.

6] How does phototropism occur in plants?

7] Which signals will get disrupted in case of a spinal cord injury?

8] How does chemical coordination occur in plants?

9] What is the need for a system of control and coordination in an organism?

10] How are involuntary actions and reflex actions different from each other?

11] Compare and contrast nervous and hormonal mechanisms for control and coordination in animals.

12] What is the difference between the manner in which movement takes place in a sensitive plant and the movement in our legs?

ZEN ADDITIONAL QUESTIONS SECTION

MULTIPLE-CHOICE QUESTIONS

1] Which of the following statements is correct about receptors?
a] Gustatory receptors detect taste while olfactory receptors detect smell
b] Both gustatory and olfactory receptors detect smell
c] Auditory receptors detect smell and olfactory receptors detect taste
d] Olfactory receptors detect taste and gustatory receptors smell [NCERT Exemplar]

2] Electrical impulse travels in a neuron from [NCERT Exemplar]
a] Dendrite → axon → axonal end → cell body
b] Cell body → dendrite → axon → axonal end
c] Dendrite → cell body → axon → axonal end
d] Axonal end → axon → cell body → dendrite

3] In a synapse, chemical signal is transmitted from
a] dendritic end of one neuron to axonal end of another neuron
b] axon to cell body of the same neuron
c] cell body to axonal end of the same neuron
d] axonal end of one neuron to dendritic end of another neuron [NCERT Exemplar]

4] In a neuron, conversion of electrical signal to a chemical signal occurs at/in [NCERT Exemplar]
a] cell body b] axonal end
c] dendritic end d] axon

5] Which is the correct sequence of the components of a reflex arc? [NCERT Exemplar]
a] Receptors→ Muscles→ Sensory neuron→ Motor neuron→ Spinal cord
b] Receptors→ Motor neuron → Spinal cord → Sensory neuron → Muscle
c] Receptors → Spinal cord → Sensory neuron → Motor neuron → Muscle
d] Receptors → Sensory neuron → Spinal cord → Motor neuron → Muscle

6] Posture and balance of the body is controlled by
a] cerebrum b] cerebellum
c] medulla d] pons [NCERT Exemplar]

7] Spinal cord originates from [NCERT Exemplar]
a] cerebrum b] medulla
c] pons d] cerebellum

8] The main function of abscisic acid in plants is to [NCERT Exemplar]
a] increase the length of cells b] promote cell division
c] inhibit growth d] promote growth of stem

9] The shape of guard cells changes due to change in the
a] protein composition of cells
b] temperature of cells
c] amount of water in cells
d] position of nucleus in the cells [NCERT Exemplar]

10] The growth of tendril in pea plants is due to
a] effect of light
b] effect of gravity
c] rapid cell divisions in tendrillar cells that are away from the support
d] rapid cell divisions in tendrillar cells in contact with the support [NCERT Exemplar]

11] The growth of pollen tubes towards ovules is due to [NCERT Exemplar]
a] hydrotropism b] chemotropism
c] geotropism d] phototropism

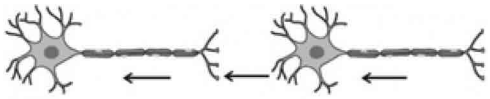
12] The substance that triggers the fall of mature leaves and fruits from plants is due to [NCERT Exemplar]
a] auxin b] gibberellin
c] abscisic acid d] cytokinin

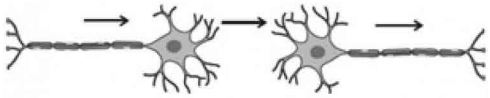
13] Involuntary actions in the body are controlled by [NCERT Exemplar]
a] medulla in fore brain b] medulla in mid brain
c] medulla in hind brain d] medulla in spinal cord

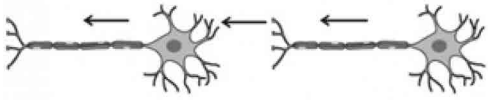
14] Which of the following is not an involuntary action? [NCERT Exemplar]
a] Vomiting b] Salivation
c] Heart beat d] Chewing

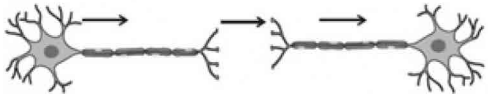
15] When a person is suffering from severe cold, he or she cannot [NCERT Exemplar]
a] differentiate the taste of an apple from that of an ice cream
b] differentiate the smell of a perfume from that of an agarbatti
c] differentiate red light from green light
d] differentiate a hot object from a cold object

16] What is the correct direction of flow of electrical impulses? [NCERT Exemplar]

a] 

b] 

c] 

d] 

17] Dramatic changes of body features associated with puberty are mainly because of secretion of [NCERT Exemplar]
a] oestrogen from testes and testosterone from ovary
b] estrogen from adrenal gland and testosterone from pituitary gland
c] testosterone from testes and estrogen from ovary
d] testosterone from thyroid gland and estrogen from pituitary gland

18] The hormone which increases the fertility in males is called [NCERT Exemplar]
a] oestrogen b] testosterone
c] insulin d] growth hormone

19] Junction between two neurons is called [NCERT Exemplar]
a] cell junction b] neuro muscular junction
c] neural joint d] synapse

20] In humans, the life processes are controlled and regulated by
a] reproductive and endocrine systems
b] respiratory and nervous systems
c] endocrine and digestive systems
d] nervous and endocrine systems [NCERT Exemplar]

21] Chemicals produced by plants to regulate plant activities are called
a] Chemicals b] Chlorophyll
c] Growth regulators d] Neurons

22] The substance that accelerates the growth in the stem is
a] Auxin b] Cytokinin
c] Enzyme d] Vitamin

23] Learning is related to
a] hypothalamus b] thalamus
c] cerebrum d] cerebellum

24] In reflex action, the reflex arc is formed by
a] muscles – receptor – brain
b] muscles- effector – brain
c] receptor- spinal cord – muscles
d] spinal cord – receptor - muscles

25] Which of the following acts as both endocrine and exocrine glands?
a] pituitary b] adrenal c] pancreas d] ovaries

26] An involuntary response to a stimulus is known as
a] jerking b] reflex
c] conditioning d] answer

27] The number of pairs of cranial nerves in humans is
a] 21 b] 31 c] 41 d] 12

28] The number of pairs of spinal nerves in humans is
a] 12 b] 31 c] 21 d] 8

29] The hormone that is used to keep flowers fresh is
a] auxin b] gibberellic acid
c] cytokinin d] ethylene

30] The hormone that speeds up the ripening process is
a] Auxin b] Gibberellin
c] Cytokinin d] ethylene

31] A spinal nerve is a _____ nerve.
a] sensory b] motor c] mixed d] long

32] Hormone produced by the ovarian follicle is _____ and in addition _____ is produced by the corpus luteum.
a] oestrogen, progesterone b] progesterone, oestrogen
c] oestrogen, thyroxin d] progesterone, thyroxin

33] The nodes of Ranvier are
a] covering of the nerve fibre
b] swelling along the nerve fibre
c] gaps in the cover of the nerve fibre
d] collection of nerves in the heart

34] The lobes - parietal, temporal, frontal and occipetal belong to
a] medulla oblongata b] cerebrum
c] cerebellum d] hypothalamus

35] The box enclosing the brain is called the
a] skull b] head
c] cranium d] vertebral column

36] The kind of nerve carrying impulses from the brain to a gland or a muscle is called
a] affector b] effector
c] mixed d] none of the above

37] Cerebellum, medulla oblongata and pons are the parts of...
a] mid-brain b] hind-brain
c] fore-brain d] spinal cord

38] Which of the following endocrine glands does not occur as a pair in human body?
a] Adrenal b] Pituitary c] Testis d] Ovary

39] Plant hormones are called...
a] phytohormones b] cytohormones
c] mesohormones d] mitohormones

40] The leaves of a sensitive plant possess a soft cushion-like structure called...
a] pulmonus b] pulvinus c] pollenus d] polynus

41] The protective and insulation sheath of myelin is found around...
a] axon b] dendrite c] cell body d] pons

42] Pons regulates...
a] body balance b] blood circulation
c] blood pressure d] respiration

43] In spinal cord, the grey matter is arranged in _____ shape.
a] H b] W c] R d] K

44] Which of the following is not an example of reflex action?
a] Sneezing b] Yawning c] Walking d] Coughing

45] Hormones have _____ effect.
a] stimulatory
b] inhibitory
c] both stimulatory and inhibitory
d] nonregulatory

46] When we touch the leaves of mimosa plant, we observe...
a] photonasty b] thermonasty
c] thigmonasty d] hydronasty

47] The flowers of lotus and sunflower open in the morning. This is an example of...
a] thigmonasty b] thermonasty
c] photonasty d] tropic movement

48] Which structure of a nerve cell receives the nerve impulse passed on by another nerve cell?
a] Dendrite b] Axon
c] Nerve fibre d] Ranvier's node

49] After travelling through the nerve cell, the nerve impulse gets converted to...
a] chemical signal b] electrical signal
c] mechanical signal d] electronic signal

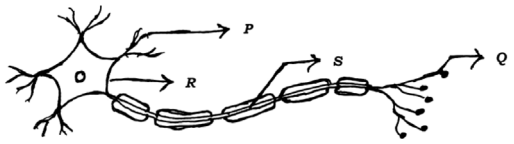
50] The brain is surrounded by membranes called...
a] corpus callosum b] meninges
c] thalamus d] lobes

51] Which of the following protects brain from mechanical shock?
a] White matter b] Grey matter
c] Dark fluid d] Cerebrospinal fluid

52] The two cerebral hemispheres are joined together by...
a] cranium b] pons
c] medulla oblongata d] corpus callosum

53] A patient experienced a sudden rise in body weight up to 6 kg within a couple of weeks. Disorder of which gland is related to this condition?
a] Adrenal b] Testes/ovary
c] Pancreas d] Thyroid

54] The correct path of the movement of nerve impulses in the following diagram is **[SSLC March 2019]**



a] Q → S → R → P b] P → Q → R → S
c] S → R → Q → P d] P → R → S → Q

55] The incorrect statement related to thyroxine hormone among the following is **[SSLC June 2020]**
a] it regulates fat metabolism
b] its deficiency leads to goitre
c] it is secreted by parathyroid gland
d] iodine in the food is essential for its production

MATCH THE FOLLOWING

1] The functions of hormones are given in **Column-A** and the names of the hormones are given in **Column-B**. Match them and write the answer along with its letters: **[SSLC April 2019]**

Column-A	Column-B
A] Prepares the body to deal with the situation	i] Growth hormone
B] Regulates metabolism for body growth	ii] Testosterone
C] Regulates blood sugar levels	iii] Adrenaline
D] Regulates the growth and development of the body	iv] Progesterone
	v] Insulin
	vi] Thyroxine
	vii] Oestrogen

VERY-SHORT ANSWER [VSA] TYPE QUESTIONS — 1 MARK

1] Why is it advised to include iodised salt in the diet? [CBSE 2015]

2] Give an example of a plant hormone that promotes its growth. Where it is synthesized? [CBSE 2014]

3] State the function of: [CBSE 2013]
i] gustatory receptors, and ii] olfactory receptors.

4] Name the part of the brain which controls posture and balance of the body. [CBSE 2012]

5] Mention the part of the body where gustatory and olfactory receptors are located. [CBSE 2012]

6] A potted plant is made to lie horizontally on the ground. Which part of the plant will show [CBSE 2012]
i] positive geotropism? ii] negative geotropism?

7] A young green plant receives sunlight from one direction only. What will happen to its shoots ? [CBSE 2009]

8] Name the plant hormones which help/promote [CBSE 2009]
i] cell division ii] growth of the stem and roots?

9] What is the function of thyroxine hormone in our body? [CBSE 2009]

10] Name two tissues that provide control and coordination in multicellular animals. [CBSE 2009]

11] Which one of the following actions on touch is an example of chemical control?
i] Movement on the touch-sensitive plant.
ii] Movement in human leg. [CBSE 2009]

12] How is spinal cord protected in human body? [CBSE 2018]

13] Name two components of central nervous system in humans. [CBSE 2018]

SHORT-ANSWER [SA] TYPE-I QUESTIONS — 2 MARKS

1] Label the parts a], b], c] and d] and show the direction of flow of electrical signals in the figure. [Exemplar][CBSE 2020]

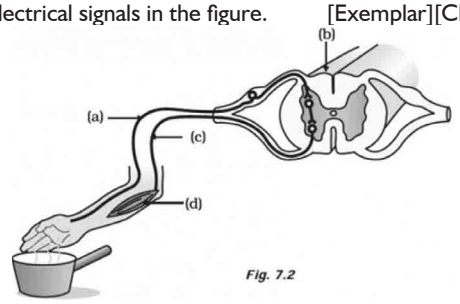
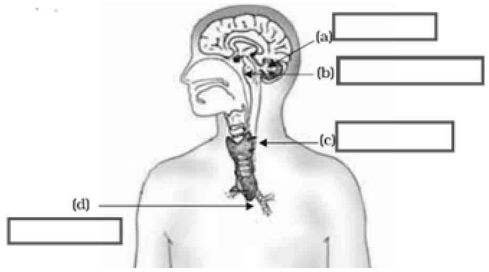


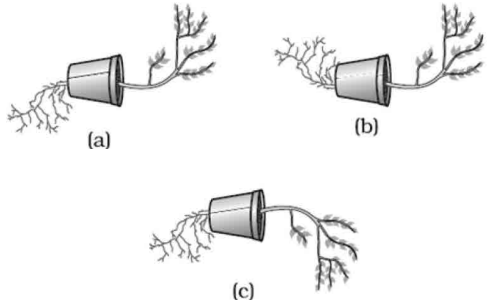
Fig. 7.2

2] Name the plant hormones responsible for the following
a] elongation of cells
b] growth of stem
c] promotion of cell division
d] falling of senescent leaves [NCERT Exemplar]

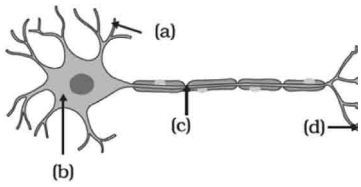
3] Label the endocrine glands in the figure. [NCERT Exemplar]



4] In the figure, a], b] and c], which appears more accurate and why? [NCERT Exemplar]



5] Label the parts of a neuron in the figure. [NCERT Exemplar]



6] Match the terms of Column A with those of Column B. [NCERT Exemplar]

Column A	Column B
a] Olfactory receptors	i] Tongue
b] Thermo receptors (temperature receptors)	ii] Eye
c] Gustatoreceptors	iii] Nose
d] Photoreceptors	iv] Skin

7] What is a tropic movement? Explain with an example. [NCERT Exemplar]

8] What will happen if intake of iodine in our diet is low? [NCERT Exemplar]

9] What happens at the synapse between two neurons? [NCERT Exemplar]

10] Answer the following: [NCERT Exemplar]
a] Which hormone is responsible for the changes noticed in females at puberty?
b] Dwarfism results due to deficiency of which hormone?
c] Blood sugar level rises due to deficiency of which hormone?
d] Iodine is necessary for the synthesis of which hormone?

11] Answer the following: [NCERT Exemplar]
a] Name the endocrine gland associated with brain?
b] Which gland secretes digestive enzymes as well as hormones?
c] Name the endocrine gland associated with kidneys?
d] Which endocrine gland is present in males but not in females?

12] Trace the sequence of events that will occur when a bright light is focussed on your eyes with the help of a diagram. OR Draw a neat labelled diagram showing the Reflex Arc. [CBSE 2019, 2015, 2010]

13] Differentiate between the following:
i] Tropic movement and nastic movement
ii] Reflex action and voluntary action
iii] Nervous system and Hormonal system

14] What is the name given to the junction between neurons? Describe how an impulse crosses this junction.

15] How does our body respond when adrenaline is secreted in the blood?

16] Name the plant hormone :
i] Which inhibits growth and causes wilting of leaves
ii] Which promotes cell division
iii] Synthesised at the shoot tip

17] Why is pituitary gland also called master gland?

18] A leaf shaped gland is present above the intestine. The secretion of this gland regulates the metabolism of sugar in blood. Name the secretion and gland.

19] Why do people living in the mountainous regions get goitre?

20] i] Name the hormones that are released in human males and females when they reach puberty.
ii] Name a gland associated with brain. Which problem is caused due to the deficiency of the hormone released by this gland ? [CBSE 2014]

21] a] Which plant hormone is present in greater concentration in the areas of rapid cell division?
b] Give one example of a plant growth promoter and a plant growth inhibitor. [CBSE 2014]

22] Name, the two main organs of our central nervous system. Which one of them plays a major role in sending command to muscles to act without involving thinking process? Name the phenomenon involved. [CBSE 2010]

23] Name the hormone secreted by human testes. State its functions. [CBSE 2010]

24] List two different functions performed by pancreas of the body. [CBSE2018]

25] a] Plants do not have any nervous system but yet, if we touch a sensitive plant, some observable changes take place in its leaves. Explain how could this plant respond to the external stimuli and how it is communicated.
b] Name the hormone that needs to be administered to
i] increase the height of a dwarf plant.
ii] cause rapid cell division in fruits and seeds. [CBSE 2019]

26] What is insulin? Why are some patients of diabetes treated by giving injections of insulin? [CBSE 2018]

27] How is the movement of leaves of the sensitive plants different from the movement of a shoot towards light? [CBSE 2018]

28] What is a nerve impulse? State the direction followed by a nerve impulse while travelling in the body of an organism. [CBSE 2018]

29] a] Why is the use of iodised salt advisable? Name the disease caused due to deficiency of iodine in our diet and state its one symptom.
b] How do nerve impulses travel in the body? Explain. [CBSE 2018]

30] a] Give the location of gustatory receptor and olfactory receptor present in human beings.
b] Write *a* and *b* in the given flow chart of neuron through which information travels as an electrical impulse. [CBSE2018]

Dendrite $\rightarrow a \rightarrow b \rightarrow$ End point of Neuron

31] Different parts of brain are associated with specific function. Name the part of human brain which performs the following function: [CBSE 2018]
a] sensation of feeling full b] vomiting
c] Picking up a pencil d] Riding a bicycle

32] State how concentration of auxins stimulates the cells to grow longer on the side of the shoot which is away from the light [CBSE 2018]

SHORT-ANSWER [SA] TYPE-2 QUESTIONS 3 MARKS

1] Draw neat diagram of human brain and label on it the following parts: [CBSE 2014]
i] Midbrain ii] Pituitary gland

2] Write one example for each of the following tropic movements: [CBSE 2014]
i] Positive phototropism ii] Negative phototropism
iii] Positive geotropism iv] Negative geotropism
v] Hydrotropism vi] Chemotropism

3] State how concentration of auxin stimulates the cells to grow longer on the side of the shoot which is away from light? [CBSE 2015]

4] What is synapse? In a neuron cell how is an electrical impulse created and what is the role of synapse in this context? [CBSE 2015]

5] List in tabular form three differences between nervous control and chemical control. [CBSE 2015]

6] Smita's father has been advised by a doctor to reduce his sugar intake. [CBSE 2015]
a] Name the disease he is suffering from and name the hormone whose deficiency is the cause.
b] Identify the gland that secretes it and mention the function of this hormone.
c] Explain how the time and amount of secretion of this hormone is regulated in human system.

7] a] How is brain protected from injury and shock?
b] Name two main parts of hind brain and state the functions of each. [CBSE 2012]

8] Which organ secretes a hormone when blood sugar rises in our body? Name the hormone and name one enzyme released by this organ. [CBSE 2011]

9] What causes a tendril to encircle or coil around the object in contact with it is? Explain the process involved. [CBSE 2011]

10] Name any three endocrine glands in human body and briefly write the function of each of them. [CBSE 2011]

11] Which part of the brain controls involuntary actions? Write the function of any two regions of it. [CBSE 2011]

12] What is chemotropism? Give one example. Name any two plant hormones and mention their functions.

13] State the functions of any three of the structural and functional unit of nervous system.

14] What is the function of receptors in our body? Think of situation where receptors do not work properly. What problems are likely to arise?

15] a] Name the two main constituents of the Central Nervous System in human beings. [CBSE 2009]
b] What is the need for a system of control and coordination in human beings?

16] A small coconut tree sapling was planted in a well lit part of the house while the house was under construction. As the construction work proceeded, the light was blocked from one side. After few years it was observed that the woody stem of the plant has turns and twists in it. Give reason for this unusual appearance of the coconut tree. [CBSE 2009]

17] List the functions of various phytohormones. [CBSE 2009]

18] Explain hydrotropism with the help of an example. [CBSE 2009]

19] A squirrel is in a scary situation. Its body has to prepare for either fighting or running away. State the immediate change that take place in its body so that the squirrel is able to either fight or run? [CBSE 2020]

20] Why is chemical communication better than electrical impulses as a means of communication between cells in a multi-cellular organism? [CBSE 2020]

21] a] What is tropism?
b] How do auxins promote the growth of a tendril around a support? [CBSE 2020]

22] A cheetah, on seeing a prey, moves towards him at a very high speed. What causes the movement of his muscles? How does the chemistry of cellular components of muscles change during this event? [CBSE 2020]

23] What are hormones? Name the hormone secreted by thyroid gland and state its function. [CBSE 2020]

24] Define geotropism. Draw a labelled diagram of a plant showing geotropic movements of its parts. [CBSE 2019, 2016]

25] Write in tabular form the location, hormone and function of the hormones secreted by each of the following glands present in the human body. [CBSE 2019, 2018]
i] Pituitary gland ii] Thyroid gland iii] Pancreas

26] What are plant hormones? Name the plant hormone responsible for the following: [CBSE 2019]
i] Growth of stem ii] promotion of cell division
ii] Inhibition of growth iv] elongation of cells.

27] Nervous and hormonal system together perform the function of control and coordination in human beings. Justify this statement with the help of an example. [CBSE 2019]

28] Why does the flow of signals in a synapse from axonal end of one neuron to dendritic end of another neuron take place but not in the reverse direction? Explain. [CBSE 2019]

29] List in tabular form three distinguishing features between cerebrum and cerebellum. [CBSE 2019]

30] a] Name the part of human brain which controls
i] voluntary actions, and ii] involuntary actions.
b] Write the function of peripheral nervous system. Name the components of this system stating their origin. [CBSE 2018]

31] How do auxins promote the growth of a tendril around a support? [CBSE 2018, 2011]

32] Name the hormone required for the following. Also, mention the name of endocrine gland from which that hormone is secreted:
i] Lowering of blood glucose.
ii] Development of moustache and beard in human males.
iii] Metabolism of carbohydrate, fats and proteins. [CBSE 2018]

33] Smita's fatherhas been advised by a doctor to reduce his sugar intake.
i] Name the disease he is suffering from and name the hormone whose deficiency causes this disease.
ii] Identify the gland that secretes itand mention the function of this hormone.
iii] Explain how the time and amount of secretion of this hormone is regulated in human system. [CBSE 2012]

34] Imagine the following situations: **[SSLC June 2019]**
i] Clapping at the end of a programme.
ii] Fluctuating blood pressure in the body.
How these situations are functionally different ? Give reason.

35] "We withdraw our leg when stepped on thorn unknowingly."
i] Trace the sequences of events which occur in this action.
ii] Which part of human nervous system controls this action? **[SSLC June 2019]**

LONG-ANSWER [LA] TYPE QUESTIONS 4/5 MARKS

1] Draw the structure of a neuron and explain its function. [NCERT Exemplar]

2] What are the major parts of the brain? Mention the functions of different parts. [NCERT Exemplar]

3] What constitutes the central and peripheral nervous systems? How are the components of central nervous system protected? [NCERT Exemplar]

4] Mention one function for each of these hormones:
a] Thyroxin b] Insulin
c] Adrenaline d] Growth hormone
e] Testosterone [NCERT Exemplar]

5] Name various plant hormones. Also give their physiological effects on plant growth and development. [NCERT Exemplar]

6] What are reflex actions? Give two examples. Explain a reflex arc. [NCERT Exemplar]

7] How does chemical coordination take place in animals? [NCERT Exemplar]

8] a] State the structural and functional unit of nervous system. Draw its neat labelled diagram and write two functions
OR
Draw the structure of neuron and label cell body and axon. [CBSE 2015, 2012]
OR
Draw the diagram showing the structure of neuron. Label the following parts : **[SSLC June 2019]**
i] The part which has prominent nucleus
ii] Dendrite.

b] Name the part of a neuron:
i] where information is acquired.
ii] through which information travels as an electrical impulse.

9] a] Explain any three directional movements in plants.
b] How brain and spinal cord are protected in human?
c] Name the master gland present in the brain.
[CBSE 2013]

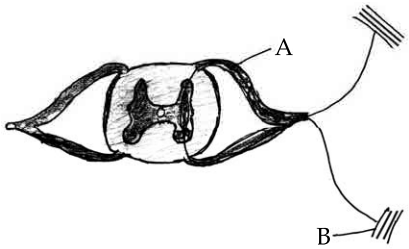
10] What is hydrotropism? Design an experiment to demonstrate this phenomenon. [CBSE 2018, 2011]

11] a] Why is the use of iodised salt advisable? Name the disease caused due to deficiency of iodine in our diet and state its one symptom.
b] How do nerve impulse travel in the body? Explain.
[CBSE 2019]

OR

Name the hormone which regulates carbohydrate, protein and fat metabolism in our body. Which gland secretes this hormone? Why is it important for us to have iodised salt in our diet? [CBSE 2018, 2015]

12] Name the given structure. What is its general function? Mention the function of the parts labelled as A and B. These structures in animals are said to be efficient ways to give quick responses. Why? **[SSLC June 2020]**



HOTS [HIGHER ORDER THINKING SKILLS] – QUESTIONS

1] The organ A which is located inside the skull of our body is protected by a bony box B and it is surrounded by 3 membranes C. The space between the membranes is filled with liquid D which protects the organ A from mechanical shock. The organ A in combination with another organ E makes up the central nervous system.
i] What is organ A?
ii] What are B, C and D?
iii] Name the organ E.
iv] If we step out from a dark room into bright sunlight, we close our eyes for a moment. Which of the two organs A or E is directly involved in this sunshine?

2] P, Q, R and S are four major types of phytohormones. P is a phytohormone which functions mainly as a growth inhibitor. It promotes the wilting and falling of leaves. Q, R and S are phytohormones which all promote growth of plant in various ways like Q is responsible for the phototropism in plants while R is involved mainly in shoot development. The phytohormone S helps in breaking the dormancy of seeds and buds. What is P, Q, R and S.

ANSWERS SECTION

IN-TEXT QUESTIONS – ANSWERS

Page no. 119:

1]

Reflex Action	Walking
Reflex action is involuntary action	Walking is voluntary action
It is controlled by spinal cord	It is controlled by brain

2] A synapse is the gap between the two neurons. At synapse the electrical signals are converted into chemical signals. The chemicals are released at the synapse. These can easily cross over the gap and trigger a response in the next neurons where it is again converted into electrical signals.

3] Cerebellum

4] The smell of the incense stick diffuses in air and reaches our nose. The olfactory receptors present in our nose detect it and sends this information to the fore brain in the form of electrical signals. Fore brain interprets this by associating the stored information from the sensory region for smell and putting together the information from the other sensory receptors as well.

5] Though reflex action is taken by the spinal cord, information of the strong stimuli simultaneously reaches the brain for interpretation and further action.

Page no. 122:

1] Plant hormones or phytohormones are chemical compounds which are released by stimulated cells. These hormones are diffused around the plant cells. They have a role to play in the cell division, cell enlargement, cell differentiation, fruit growth, falling of leaves, ripening of fruits, ageing of plants etc.

2] The movement of leaves of the sensitive plant is a nastic movement, i.e. it does not depend on the direction of the stimulus. On the other hand, the movement of a shoot towards light is a tropic movement, i.e. it depends on the direction of the light [stimuli].

3] Auxin, cytokinin.

4] The tendrils are sensitive to touch. When they come in contact with any support, the part of the tendril in contact with the object does not grow as rapidly as the part of the tendril away from the object.

The reason:
The auxin diffuses away from the part of the tendril that is in contact with the support towards the direction opposite to it. This concentration of auxin stimulates the cells to grow longer on the side of the shoot which is away from the support. This causes the tendril to circle around the object and thus cling to it.

5] AIM: To demonstrate hydrotropism in plants.
Procedure:
i] Plant a seedling in a vessel containing soil.
ii] Adjacent to the seedling put a porous pot containing water.
iii] Leave the set up for few days.
Observation:
iv] On examining the roots of seedlings it is observed that the roots bend towards the source of water and do not grow straight.

Result:

It confirms that plant shows hydrotropism as the roots bend towards the porous pot of water. As hydrotropism is a plant growth response in which the direction of growth is determined by a stimulus of gradient in water concentration.

Page no. 125:

1] Chemical coordination takes place in animals with the help of hormones. Hormones are the chemical compounds that are secreted by the glands of the endocrine system. .

The hormones are released into the blood which carries them to different parts of the body. When this hormone reaches specific target cells, which have special signals to detect this compound, these target cells would be able to recognise the information and even transmit it. The advantage of chemical signals is that it would reach all cells of the body and does not rely on specialised structures like nervous connections.

Hormones regulate the overall growth and development of the animals.

2] Iodine is necessary for the making of thyroxine hormone by thyroid gland; Deficiency of iodine in the diet can cause a deficiency of thyroxine hormone in the body. Hence people are advised to use iodised salt in cooking to prevent Goitre disease.

3] When adrenaline is secreted into the blood, it is carried to different parts of the body. One of the target organs of the hormone is the heart. The following reactions are observed in the body as a response to the hormone:

- The heart beats faster, resulting in supply of more oxygen to our muscles.
- The blood to the digestive system and skin is reduced due to contraction of muscles around small arteries in these organs. This diverts the blood to our skeletal muscles.
- The breathing rate also increases because of the contractions of the diaphragm and the rib muscles.

All these responses together enable the animal body to be ready to deal with the situation.

4] Insulin is a hormone secreted by pancreas that regulates the sugar level in the blood. When this hormone is not synthesised in proper amount then the sugar level in the blood rises and the persons suffer from diabetes. This is the reason why diabetic patients are treated by giving injections of insulin.

TEXTUAL EXERCISE – ANSWERS

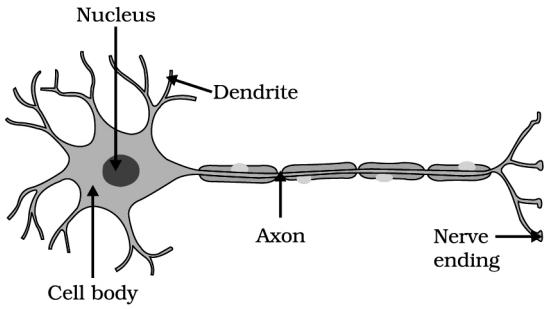
1] d] Cytokinin.

2] b] synapse.

3] d] all of the above.

4] Receptors are present in all parts of our body like skin, eye, ear, nose, tongue etc. They detect the signals and then send them to brain in the form of electrical signals. The brain then instructs a muscle or gland of the related organ to take necessary action. If these receptors fail to work, then they will not detect the input signal. This will affect the functioning of the respective organ. Eg: if the receptors in the eye fails, then the person cannot see anything and will be visually impaired.

5]



Dendrite: It detects information and conducts the messages towards the cell body.

Cell body: It contains nucleus, mitochondria, and other cell organelles. It maintains the growth of the cell.

Axon: It conducts messages away from the cell body and passes to the next neuron. It transmits messages in the form of electrical signals.

Nerve terminals:

Each terminal is connected to other neurons across a small gap called a synapse.

6] Auxin concentration in a particular plant part changes as a response to the direction of light. For example: in a stem, concentration of auxin increases in those parts which are away from light. This increases cell division in that part and thus the stem bends towards light. That is how phototropism occurs in plants.

7] Nerves from all over the body meet at spinal cord on their way to the brain. In case of any injury to the spinal cord, the signals coming from the nerves to the brain as well as the signals coming to the receptors from the brain will be disrupted.

8] Chemical coordination in plants occurs due to plant hormones. Most of the hormones in plants help in promoting growth in plants. Eg: auxin, gibberellin and Cytokinins.

Abscisic acid is a plant hormone that inhibits growth eg: Shedding and yellowing of leaves.

9] An organism is made up of many tissues, organs and organ system. Each of these is responsible to perform a particular function required for the maintenance of the organism. All these need to be controlled and coordinated for the smooth functioning of the body of the organism.

Any external stimuli received by the body, is processed and appropriate response is initiated.

Eg: a deer runs [response] on sighting a lion[stimuli].

The control and coordination system helps in:

a] Integrating various metabolic activities

b] Growth of the organisms

c] Responding to an external stimuli in order to protect themselves or the attain nutrition.

10] Involuntary actions are actions that are not under our control but are decisions taken by the brain. It involves smooth muscles, eg: peristaltic movement of intestine, beating of the heart.

Reflex action is an immediate action taken by the spinal cord much before the information reaches the brain. It does not involve thinking. It involves skeletal muscles/ glands. Eg: salivating on spotting food.

11]

	Nervous system	Hormonal mechanism
1	The transmission of information is in the form of electrical signals	The transmission of information is in the form of chemical signals
2	The electrical signals will reach only those cells that are connected by nervous tissue, not each and every cell in the animal body	The hormones would diffuse all around the original cell. If other cells around have the means to detect this compound using special molecules on their surfaces, then they would be able to recognise information, and even transmit it
3	Once an electrical impulse is generated in a cell and transmitted, the cell will take some time to reset its mechanisms before it can generate and transmit a new impulse. In other words, cells cannot continually create and transmit electrical impulses	he chemical signal is transmitted steadily and persistently. It does not require any reset time
4	It is faster	It is slow

12]

Movement in sensitive plant	Movement in our legs
This is an involuntary action; nastic movement	This is voluntary action
No special tissue is there for the transfer of information	This movement takes place with the transfer of information with the nervous system
No specialised proteins assist in movement	Specialised proteins help muscles to contract thereby helping the legs to move

ZEN ADDITIONAL QUESTIONS - ANSWERS

MULTIPLE-CHOICE ANSWERS

1] a] Gustatory receptors detect taste while olfactory receptors detect smell

2] c] Dendrite → cell body → axon → axonal end

3] d] axonal end of one neuron to dendritic end of another neuron

4] b] axonal end

5] d] Receptors → Sensory neuron → Spinal cord → Motor neuron → Muscle

6] b] cerebellum

7] b] medulla

8] c] inhibit growth

9] c] amount of water in cells

10] c] rapid cell divisions in tendrillar cells that are away from the support

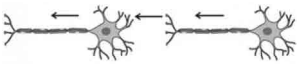
11] b] chemotropism

12] c] abscisic acid

13] c] medulla in hind brain

14] d] Chewing

15] b] differentiate the smell of a perfume from that of an agarbatti

16] c] 

17] c] testosterone from testes and estrogen from ovary

18] b] testosterone

19] d] synapse

20] d] nervous and endocrine systems

21] c] Growth regulators

22] a] Auxin

23] c] cerebrum

24] c] receptor- spinal cord – muscles

25] c] pancreas

26] b] reflex

27] d] 12

28] b] 31

29] c] cytokinin

30] d] ethylene

31] c] mixed

32] a] oestrogen, progesterone

33] c] gaps in the cover of the nerve fibre

34] b] cerebrum

35] c] cranium

36] b] effector

37] b] hind-brain

38] b] Pituitary

39] a] phytohormones

40] b] pulvinus

41] a] axon

42] c] blood pressure

43] a] H

44] c] Walking

45] c] both stimulatory & inhibitory

46] c] thigmonasty

47] b] thermonasty

48] a] Dendrite

49] a] chemical signal

50] b] meninges

51] d] Cerebrospinal fluid

52] d] corpus callosum

53] d] Thyroid

54] d] P → R → S → Q

55] c] it is secreted by parathyroid gland

MATCH THE FOLLOWING

1]

Column-A	Column-B
A] Prepares the body to deal with the situation	iii] Adrenaline
B] Regulates metabolism for body growth	vi] Thyroxine
C] Regulates blood sugar levels	v] Insulin
D] Regulates the growth and development of the body	i] Growth hormone

VERY-SHORT ANSWER [VSA] TYPE QUESTIONS – ANSWERS

1] Iodine stimulates the thyroid gland to produce thyroxin hormone. Deficiency of this hormone results in the enlargement of the thyroid gland. This can lead to goitre.

2] Plant hormone that promotes growth is auxin. It is synthesized at the tip of the plant stem.

3] i] Gustatory receptors are taste receptors found in the tongue.
ii] Olfactory receptors - to smell.

4] Cerebellum in hind-brain controls the posture and balance of the body.

5] Both gustatory receptors and olfactory receptors are located in the fore-brain.

6] i] Root ii] Shoot.

7] Shoots will bend towards the light and roots away from the light.

8] The plant hormones which help or promote:
i] Cell division — Cytokinins
ii] Growth of the stem — Gibberellins

9] Thyroxine hormone regulates the carbohydrate, protein and fat metabolism in the body so as to provide the best growth balance.

10] The two tissues that provide control and coordination in multicellular animals are nervous and muscular tissues.

11] i] Movement on the touch-sensitive plant.

12] Inside vertebral column.

13] Two components of central nervous system in humans are brain and spinal cord.

SHORT-ANSWER [SA] TYPE-1 QUESTIONS – ANSWERS

1] a] Sensory neuron
b] Spinal cord (CNS)
c] Motor neuron d] Effector = Muscle in arm

2] a] Auxin b] Gibberellin
c] Cytokinin d] Abscisic acid

3] a] Pineal gland b] Pituitary gland
c] Thyroid d] Thymus

4] Figure a] is more appropriate because in a plant shoots are negatively geotropic hence, grow upwards and roots are positively geotropic so grow downwards.

5] a] Dendrite b] Cell body
c] Axon d] Nerve ending

6]

Column A	Column B
a] Olfactory receptors	iii] Nose
b] Thermo receptors temperature receptors	iv] Skin
c] Gustatoreceptors	i] Tongue
d] Photoreceptors	ii] Eye

7] The directional growth movements of plants due to external stimuli are called tropic movement. It can be either towards the stimulus, or away from it. For example, in case of phototropic movement, shoots respond by bending towards light while roots respond by bending away from it.

8] a] When iodine intake is low, release of thyroxin from thyroid gland will be less by which protein, carbohydrate and fat metabolisms will be affected.
b] A person might suffer from goitre in case of iodine deficiency in the body.

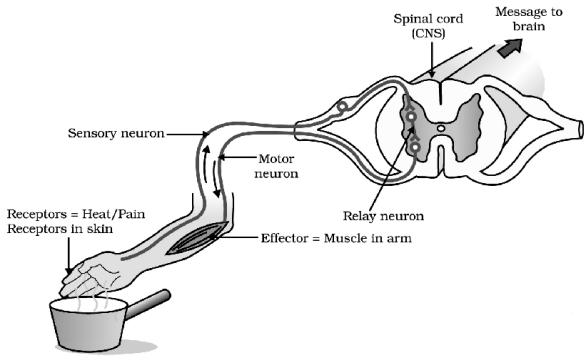
9] When an electrical signal reaches the axonal end of one neuron it releases certain chemical substances called neurotransmitters that cross the synapse and move towards the dendritic end of next neuron generating another electrical signal.

10] a] Oestrogen b] Growth hormone
c] Insulin d] Thyroxin

11] a] Pituitary b] Pancreas
c] Adrenal d] Testes

12] When a bright light is focussed on the eyes, sensory receptor cells receive the message and passes on the information to sensory neurons. The sensory neurons take the information to the brain and the brain sends back the orders through motor neurons to the iris muscles which contracts the pupil.
Receptor → Sensory neuron → Brain → Motor neuron → Eye → Eye muscle [iris] contracts → pupil contracts.

Or



Reflex Arc

13] i]

Tropic movement	Nastic movement
These movements in plants are directional.	These movements in plants are not directional.
They are both stimulus and growth dependent. It can be either towards the stimulus, or away from it.	They are not dependent on stimulus and are growth independent.
Eg: phototropic movement, shoots respond by bending towards light	Eg: touch me not plant leaves fold and droop as a response to various external stimuli like touch or warming, shaking or blowing..

ii]

Reflex action	Voluntary action
These are sudden involuntary reactions as a response to external stimuli.	These are actions that are done at will.
Does not involve thinking.	It involves thinking
It is generally the immediate action taken by the spinal cord even before the message reaches the brain. It helps in preventing damage to any part of the body.	It is a well thought out action taken by the brain.

iii]

Nervous system	Hormonal system
It is comprised of nerves, brain and spinal cord.	It is comprised of glands and hormones.
The information is transmitted in the form of electrical signals.	The information are transmitted as chemical signals.
Transmission of information is faster.	Transmission of information is slow.
Information will reach only those cells that are connected by nervous tissue, not each and every cell in the animal body.	Hormones would diffuse all around the original cell. If other cells around have the means to detect this compound using special molecules on their surfaces, then they would be able to recognise information, and even transmit it.
Once an electrical impulse is generated in a cell and transmitted, the cell will take some time to reset its mechanisms before it can generate and transmit a new impulse.	Transmission of chemical signal does not require any reset time. It is steady and persistent.

14] Two neurons do not make direct contact. Where they meet, there is a very small gap called a synapse.

Signals cross this gap using chemicals released by a neuron. The chemical diffuses across the gap makes the next neuron transmit an electrical signal.

i] An electrical impulse travels along an axon.

ii] This triggers the nerve-ending of a neuron to release chemical messengers called neurotransmitters.

iii] These chemicals diffuse across the synapse [the gap] and bind with receptor molecules on the membrane of the next neuron.

iv] The receptor molecules on the second neuron bind only to the specific chemicals released from the first neuron. This stimulates the second neuron to transmit the electrical impulse.

15] • The heart beats faster, resulting in supply of more oxygen to our muscles.

• The blood to the digestive system and skin is reduced due to contraction of muscles around small arteries in these organs. This diverts the blood to our skeletal muscles.

• The breathing rate also increases because of the contractions of the diaphragm and the rib muscles.

All these responses together enable the animal body to be ready to deal with the situation.

16] i] Abscisic acid ii] Cytokinin iii] Auxin

17] It is the main endocrine gland. It is a small structure in the head. It is called the master gland because it produces hormones that control other glands and many body functions including growth.

18] Insulin and the gland is pancreas

19] Goitre is a common disease in mountainous regions.

Reason: The diet of the people in mountains lacks iodine content. Unlike sea foods, mountainous food is not rich in iodine. Hence they have the risk of getting goitre.

20] i] Testes in males produces hormone testosterone.

Ovaries in females produces hormone oestrogen.

ii] Pituitary gland present in the brain is responsible for body growth, development of bones and muscles (if excess-gigantism) (if less-dwarfism).

21] a] Cytokinin is present in greater concentration in the areas of rapid cell division.

b] A plant growth promoter is gibberellins and a plant growth inhibitor is Abscisic acid.

22] The two main organs of CNS are brain and spinal cord. Spinal cord plays a major role in sending command to muscles to act without involving thinking process. This phenomenon is called reflex action.

23] Testes secrete male sex hormone called testosterone. The function of testosterone is to regulate male accessory sex organs and secondary sexual characters like moustache, beard and voice.

24] i] Pancreas act as a gland by secreting pancreatic juice which contains enzymes.

ii] Secretes hormones like

Insulin: regulates/ decreases blood sugar level.

Glucagon: regulates / increases blood sugar level

25] a] The plant will immediately change the shape by changing the amount of water in them (swelling or shrinking) thus bringing movement.

b] i] Gibberellin/Auxin ii] Cytokinin

26] Insulin - A hormone produced in the pancreas which regulates the amount of glucose in the blood.

To reduce blood glucose levels.

27]

Movement of leaf in sensitive plant	Movement of a shoot towards light
Movement in response to the stimulus of touch independent of direction of stimulus	Movement in response to the direction of stimulus.
Independent of growth	Growth movement

28] Nerve impulse – an electrical signal transmitted along a nerve fibre. This impulse travels from the dendrite to the cell body and then along the axon to its end.

29] a] Iodine is essential for functioning of thyroid / formation of thyroxine hormone • Disease is Goitre • Swollen neck

b] Impulse travels from dendrite to cell body, then along the axon to its end. At the end some chemicals are released which fill the gap of synapse, and starts a similar electrical impulse to another neuron and the impulse further travel in the body.

30] a] Gustatory receptor: present in tongue for detection of taste.

Olfactory receptor: present in nasal cavity for detection of smell.

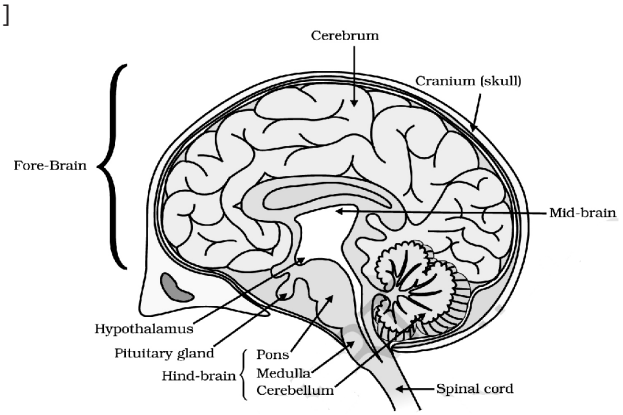
b] *a*- Cell body/ cyton, *b*- Axon

31] a] Forebrain b] hindbrain(medulla)
c] Hindbrain(cerebellum) d] hindbrain (cerebellum)

32] When a growing plant detects light, auxin synthesises at the shoot tip to help the cells to grow longer. When light comes from one side, auxin diffuses towards the shady side of the shoot. This concentration of auxin stimulates the cells to grow longer on the side of the shoot which is away from light and plant appears to bend towards light.

SHORT-ANSWER [SA] TYPE-2 QUESTIONS – ANSWERS

1]



2] i] Positive phototropism: shoots growing towards light.

ii] Negative phototropism: roots growing away from light towards ground.

iii] Positive geotropism: growth of roots towards earth due to the pull of the earth.

iv] Negative geotropism: shoots growing away from the earth.

v] Hydrotropism: roots growing towards the source of water.

vi] Chemotropism: growth of pollen tubes towards the ovules.

3] When light falls on the side of the shoot, auxin diffuses towards the shady side of the shoot. This concentration of the auxin stimulates the cell to grow longer on the side of the shoot which is away from light. Thus plant appears to bend towards light.

4] A synapse is the gap between the two neurons. Here the axon terminal of one neuron is in close proximity to the dendrite of the second neuron. When a nerve impulse reaches the knob like nerve ending of an axon, a tiny amount of a chemical substance is released in the synapse. This chemical substance is called as the neurotransmitter. At synapse the electrical signals get converted into chemicals that can easily cross over the gap and pass on to the next neurons where it again is converted into electrical signals.

5]

Nervous control	Chemical control
It is comprised of nerves, brain and spinal cord.	It is comprised of glands and hormones.
The information is transmitted in the form of electrical signals.	The information is transmitted as chemical signals.
Transmission of information is faster.	Transmission of information is slow.
Information will reach only those cells that are connected by nervous tissue, not each and every cell in the animal body.	Hormones would diffuse all around the original cell. If other cells around have the means to detect this compound using special molecules on their surfaces, then they would be able to recognise information, and even transmit it.
Once an electrical impulse is generated in a cell and transmitted, the cell will take some time to reset its mechanisms before it can generate and transmit a new impulse.	Transmission of chemical signal does not require any reset time. It is steady and persistent.

6] a] He is suffering from diabetes. Deficiency of insulin causes diabetes.

b] Pancreas secretes insulin. Insulin helps in regulating blood sugar.

c] When the sugar level in blood increases, it is detected by the pancreas which responds by producing more insulin. As the blood sugar level falls, insulin secretion is reduced. This kind of regulation of hormones is called as feedback mechanism.

7] a] i] Brain has a three layered membrane called meninges.

ii] In between the layers of meninges and brain, a fluid named Cerebro Spinal Fluid [CSF] is filled which acts as a shock absorber.

iii] The [cranium] hard skull covers the meninges.

b] Two main parts of hind-brain are — Medulla oblongata and cerebellum.

Medulla:

It is responsible for involuntary actions such as blood pressure, salivation and vomiting.

Cerebellum:

It is responsible for precision of voluntary actions and maintaining the posture and balance of the body.

8] Pancreas secretes a hormone when blood sugar rises in our body. Insulin is the hormone released by this organ and the name of the enzyme is pancreatic juice.

9] When a tendril comes in contact with any support, the part of the tendril in contact with the object does not grow as rapidly as the part of the tendril away from the object. This causes the tendril to circle around the object and thus, cling to it.

10] Three endocrine glands with their function in human body are as follows:

a] Thyroid gland : It secretes a hormone called thyroxine which regulates the metabolism of carbohydrates, fats and proteins in the body .

b] Adrenal gland : It secretes two hormones—adrenalin and corticoid hormones and regulate blood pressure, heartbeat, breathing rate and carbohydrate metabolism.

c] Pancreas: It secretes two hormones—insulin and glucagon. Insulin hormone lowers the blood glucose level. Glucagon hormone increases the blood glucose level.

11] Hind-brain controls the involuntary actions. Cerebellum controls the coordination of body movement and posture. Medulla oblongata controls involuntary actions like swallowing, coughing, sneezing and vomiting.

12] Chemotropism is the movement of a part of the plant in response to a chemical stimulus. It can be positive chemotropism or negative chemotropism. Example: The growth of pollen tube towards a chemical which is produced by an ovule during the process of fertilisation in a flower.

Two plant hormones with their functions are as follows:

Auxins promote cell elongation, root formation.

Gibberellins stimulate stem elongation, seed germination and flowering.

13] The structural and functional unit of nervous system, i.e. neuron with their functions are as follows:

Cell body: Stimulus received from dendrite is changed into electrical impulse in the cyton.

Dendrites: They receive stimulus, which may be physical or chemical.

Axon: It conducts electrical impulse away from the cell body.

14] Receptors are present in all parts of our body for example in skin, eye, nose, tongue etc. They detect the signals and then send them to brain in the form of electrical signals. If these receptors are damaged then it they will not detect the input which leads to the harm for our body in dangerous situation.

15] a] The two main constituents of the Central Nervous System in human beings are the brain and the spinal cord.

b] A living being does not live in isolation. It has to constantly interact with its external environment and has to respond properly for its survival. For example; when a hungry lion spots a deer, the lion has to quickly make a move so that it can have its food. On the other hand, the deer needs to quickly make a move to run for its life. The responses which a living being makes in relation to external stimuli are controlled and coordinated by a system; especially in complex animals. So, control and coordination is essential in maintaining a state of stability and a steady state between the internal conditions of an organism and the external environment.

16] The plant has received sunlight only from certain directions at different period during the construction work. Hence the auxin has accumulated in the shady part of the plant resulting in cell elongation of that part of the stem. This would have resulted in bending of the plant in the direction of sunlight. Every time the direction of the sun light changes, the plant has bent in that direction as a response to light.

Hence it has an unusual appearance of the trunk.

17] i] Auxins control the tropic (growth related) movements of the plants in response to light, gravity, touch etc by increasing the size of cells. Under the influence of auxins, the plant stem bends towards unidirectional light where as the roots bend away from it.

ii] Gibberellins stimulate stem elongation and leaf expansion.

iii] Cytokinins are produced in regions of the plant body where rapid cell division occurs, such as root tips, developing shoot buds, young fruits and seeds.

iv] Ethylene causes ripening of the fruits.

v] Abscisic acid inhibits (i.e., slows down) the growth in different parts of the plant body. It causes the drying and falling of older leaves, flowers and fruits.

18] i] A porous pot filled with water is taken and inserted in a tub filled with dry sand.

ii] A freshly germinated pea seedling is sowed in the sand.

iii] As water is not available in sand, the root growing will bend towards the porous pot filled with water.

iv] A hydrotropic curvature of the root is observed as it grows towards water.

v] This bending of root shows the movement in response towards water.

The movement of the plant root towards water is positive hydrotropism.

19] The following immediate changes take place in the squirrel body which makes it able to either fight or run are:

- Breathing rate increases because of contractions of the diaphragm and the rib muscles.
- Heart beats faster resulting in supply of more oxygen to the muscles.
- Adrenaline is secreted directly into the blood and carried to different parts of the body.
- The blood to the digestive system and skin is reduced due to contraction of muscles around small arteries in these organs.

20] Chemical communication is better than electrical impulses as a means of communication between cells in a multi-cellular organism because:

- Chemical communication is a steady and a persistent response.
- The electrical impulses reach only those cells that are connected by nervous tissue and do not reach each and every cell.

The cell takes some time to reset its mechanisms for the generation and transmission of a new impulse after the generation and transmission of an electrical impulse.

21] a] The plants adapt themselves according to the change in the environment, the action of plants according to the factors around it is known as tropisms. Tropisms is the growth of

plants in response to stimulus as an example light, gravity, water and touch-types of tropisms are phototropism, gravitropism, hydrotropism and thigmotropism

b] The auxins is a plant hormone, it is present in the tendril of the plants. When tendril comes in contact with anything it grows faster towards the thing due to thigmotropism it is that's why tendril gets coiled around the support.

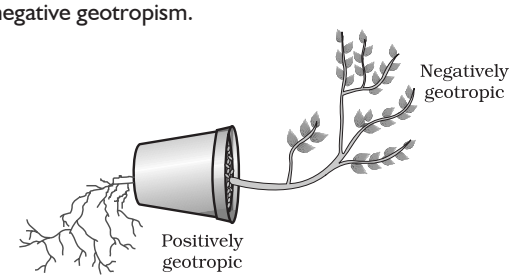
22] Nerve Impulse and Structure of Special Proteins in Muscle Fibre. On seeing the prey, an impulse is sent from the brain to the muscles in it's limbs so that the cheetah can run towards the prey. Muscles have special proteins that change both their shape and their arrangement in the cells, new arrangement of the proteins give different forms to the muscle cells, i.e. Shorter or Larger form.

Therefore, the cheetah is able to run after the prey due to the arrangement of cellular components (proteins) in the muscles.

23] Hormones are the chemicals secreted by the group of cells or tissues called glands.

Thyroxine is secreted by thyroid gland and its function is to regulates carbohydrate protein and fat metabolism.

24] The movement of plant growth towards or against gravity is called geotropism. When the movement is towards gravity it is positive geotropism and when it is against the gravity it is negative geotropism.



25]

Gland	Hormone	Location	Function
Pituitary gland	Growth hormone	Brain	Controls all the other endocrine gland. Secretes growth hormone
Thyroid gland	Thyroxine	Neck	Secrete thyroxine, regulates carbohydrate protein and fat metabolism
Pancreas	Insulin Glucagon	Abdomen	Secrete insulin, maintains blood sugar level.

26] Plant hormones – Chemical substances which help the plant to coordinate its growth and development.

i] Auxins/ Gibberellins ii] Cytokinin

iii] Abscisic Acid / ABA iv] Auxins/ Gibberellins

27] For nervous and hormonal systems to control and coordinate in human beings, hypothalamus plays an important role in receiving the neural / nerve signals from brain and release hormones.

Example: In situation of iodine deficiency, hypothalamus releases hormones to stimulate pituitary gland, it further sends stimulating hormone to thyroid gland to secrete thyroxine that regulates carbohydrate metabolism.

28] Signals in a synapse flow from axonal end of one neuron to dendritic end of another neuron but not the reverse because when this electrical signal after reaching the axonal end releases a chemical called neurotransmitter. This chemical then moves towards the dendrite end of the other neuron which generates an electrical signal. Since the chemicals are absent at the dendrite of neuron, the impulse can travel only from one side. In this way it is ensured that nerve impulse travel in only one direction (unidirectional).

29]

Cerebrum	Cerebellum memory
It is a part of fore brain	It is a part of hind brain
It initiates intelligence, memory, voluntary movements etc.,	It maintains posture and equilibrium
Main thinking part of the brain.	Controls voluntary actions like walking in a straight line, picking up a pencil, riding a bicycle etc.

30] a] i] Fore brain / cerebrum ii] brain / medulla oblongata

b] PNS helps in facilitating the communication between CNS and other parts of the body.

Components of PNS:

- Cranial Nerves – Brain
- Spinal Nerves - Spinal Cord

31] When tendril comes in contact with any support

- Auxin diffuses towards the part away from the contact.
- The part in contact with support does not grow as rapidly as the part of tendril away from the support causing the tendril to coil around the support.

32]

	Hormone	Endocrine gland
Lowering of blood glucose	Insulin	Pancreas
Development of mustache and beard in human males.	Testosterone	Testis
Metabolism of carbohydrate, fats and proteins.	Thyroxine	Thyroid

33] i] He is suffering from diabetes. Deficiency of insulin causes diabetes.

ii] Pancreas secretes insulin. Insulin helps in regulating blood sugar.

iii] When the sugar level in blood increases, it is detected by cells of the pancreas which responds by producing more insulin blood. As the blood sugar level falls, insulin secretion is reduced.

34] i] **Voluntary action:** Based on deciding what to do next (Action performed based on thinking), Controlled by forebrain.

ii] **Involuntary action:** Action without thinking control, Controlled by hind brain.

35] a] i] Receptors receive the stimulus of pain

ii] Messages reach spinal cord through sensory neuron.

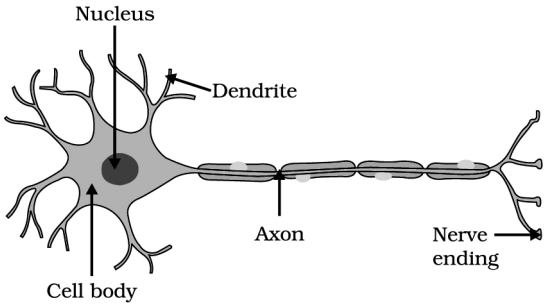
iii] Responses reach motor neuron through association neuron.

iv] Responses reach effector through motor neuron.

v] Muscles withdraw the leg.

b] Spinal cord / reflex arc.

1]



Neurons are nerve cells which are the functional units of the nervous system. The three main parts of a neuron are dendrite, cell body and axon.

Functions of the parts of the neuron:

Dendrite: It detects information and conducts the messages towards the cell body.

Cell body: It contains nucleus, mitochondria, and other cell organelles. It maintains the growth of the cell.

Axon: It conducts electrical impulses away from the cell body and transmits it to the next neuron.

2] Brain has three major parts:

Forebrain, midbrain and hindbrain.

i] Fore-brain/ cerebrum:

It is the main thinking part of the brain. It is the largest and most prominent part of the brain. It is divided into right and left cerebral hemispheres by a deep groove. It is the centre of consciousness, thoughts, memory and analytical thinking. It also controls voluntary actions.

ii] Mid-brain - It acts as a coordinating unit between forebrain and hindbrain. It also controls some involuntary actions.

iii] Hind-brain - It has three main centres: Cerebellum, Pons and Medulla oblongata.

a] Cerebellum- It is responsible for precision of voluntary actions and maintaining the posture and balance of the body.

b] Pons: It is the center through which nerve impulses travels to and from the cerebellum, spinal cord and other parts of the brain. It also helps in respiration.

c] Medulla oblongata - It is the lowermost part of the brain. It contains vital centres for controlling blood pressure, respiration, swallowing, sneezing, coughing, salivation and vomiting.

3] Central nervous system (CNS): The central nervous system is the part of the nervous system that consists of the brain and spinal cord. The peripheral nervous system (PNS) comprises of the cranial and the spinal nerves. It connects the central nervous system(CNS) to sensory organs (such as the eye and ear), other organs of the body, muscles, blood vessels and glands.

Brain is protected by the cranium while the spinal cord is protected by the vertebral column.

4] a] Thyroxin regulates carbohydrate, fat and protein metabolism.

b] Insulin — regulates blood sugar

c] Adrenaline — increases heart rate and supply of blood to various organs. It helps in a fight or a flight situation.

d] Growth hormone — regulates growth and development

e] Testosterone — controls the changes of body features associated with puberty in male and production of sperms.

5] The various plant hormones are:

Auxin , Gibberellin, Cytokinin, Abscisic acid.

Auxin: It helps in growth of the tissues. When growing plants detect light, a hormone called auxin, synthesised at the shoot tip, helps the cells to grow longer. When light is coming from one side of the plant, auxin diffuses towards the shady side of the shoot. This concentration of auxin stimulates the cells to grow longer on the side of the shoot which is away from light. Thus, the plant appears to bend towards light.

Gibberellin: Helps in the growth of the stem.

Cytokinin: Promote cell division; they are present in greater concentration in areas of rapid cell division, such as in fruits and seeds.

Abscisic acid: Inhibits growth. Wilting of leaves is due to abscisic acids.

6] Reflex action is an immediate, unconscious, involuntary response of effectors to a stimulus without the involvement of the brain. (The information will simultaneously be transmitted to the brain for further action).

Example, on touching a hot object (stimulus), we immediately remove our hand from it.

Other examples are watering of mouth on seeing food, sneezing, blinking of eyes and yawning.

Reflex Arc: The pathway of reflex action is termed as reflex arc. As a response to a strong stimuli, sensory nerves transmit the information to the spinal cord. The relay neurons in the spinal cord receives the messages from the sensory nerves and transmits the messages to the motor nerves. These motor nerves carry the messages to the muscles or glands and the effector organs responds quickly to avert any major damage to the tissues.

7] Chemical coordination in animals is controlled by endocrine system. The endocrine system coordinates the activities of the body with the nervous system. Endocrine system comprises of endocrine glands and hormones. Hormones are chemical substances produced by the endocrine glands. They act as messengers between the nervous system and the body organs.

Hormones are released directly into the nearby blood vessels, from where they are carried to specific tissues or organs called target tissues or target organs.

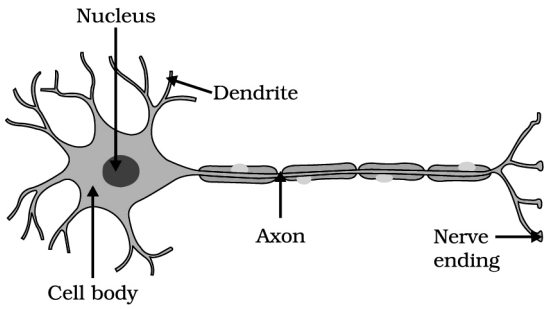
There are many glands and hormones in different animal species. Different endocrine glands secrete different hormones. In the target tissues, hormone triggers a specific biochemical or physiological activity. Hormones have a wide range of effects and modulate many different body processes like regulation of blood glucose, hunger, metamorphosis, stress, growth and so on.

8] a] The structural and functional unit of the nervous system is the neuron.

The functions of the neuron are:

i] to receive and send messages in the form of electric impulse (inside the neuron) and chemical signal(At synapse).

ii] Reflex action- spontaneous, involuntary and automatic response to a stimulus to protect us from harmful situations.



b] A nerve cell (Neuron)

i] Dendrite ii] Axon

Part of the neuron that has prominent nucleus - Cell body

9] a] The movement of plant parts towards or away from the stimuli is called as Tropic Movement.

Phototropism: movement of plant towards or away from the light.

Geotropism: movement of plant parts towards the earth or away from it.

Hydrotropism: movement of plant parts towards or away from any source of water.

b]
- Both the brain and the spinal cord are protected by bone: the brain by the bones of the skull and the spinal cord is protected by vertebrae.
- They have layers of membranes called meninges as well as a special fluid called cerebrospinal fluid. This fluid helps to protect the nerve tissue to keep it healthy, and remove waste products and acts as a shock absorber too.

c] Pituitary gland is known as the master gland.

10] 'Hydrotropism' is the directional growth of a plant part in response to water. For example, roots show hydrotropism as they grow towards water in the soil and are positively hydrotropic.

An experiment to demonstrate hydrotropism is as follows:

i] A porous pot filled with water is taken and inserted in a tub filled with dry sand.

ii] A freshly germinated pea seedling is sowed in the sand.

iii] As water is not available in sand, the root growing will bend towards the porous pot filled with water.

iv] A hydrotropic curvature of the root is observed as it grows towards water.

v] This bending of root shows the movement in response towards water.

11] a] Iodine is necessary for the thyroid gland to produce thyroxine hormone. Thyroxine regulates the metabolism of carbohydrate, protein and fat in the body to provide the best balance for growth. Deficiency of iodine in our diet causes goiter. Symptom is swelling of neck.

b] The information acquired at the end of the dendrite tip of a neuron sets off a chemical reaction which creates an electrical impulse. The impulse travels from the dendrite to the cyton along the axon to its end. At the end of the axon, the electrical impulse sets off the release of some chemicals which cross the synapse and start a similar electrical impulse in a dendrite of the next neuron. In this way, nerve impulse travels in the body.

12] The given structure is Reflex arc (spinal cord). It gives sudden action in response to the event happening in the environment.

Part A - Sensory neuron: It conducts the impulse of stimulus from receptor to the spinal cord.

Part B - Effectors: Which shows the sudden visible response.

Reflex arcs have evolved in animals because the thinking process of brain is not fast enough in many animals. Mean while many animals have very little of the complex neuron network needed for thinking. So it can function in the absence of true thought process and increase the chance of survival.

HOTS [HIGHER ORDER THINKING SKILLS] – ANSWERS

1] i] A- brain

ii] B- cranium; C- meninges D- cerebrospinal fluid

iii] E- spinal cord iv] Brain

2] P- Abscisic acid, Q- auxin

R- Gibberellin S- cytokinin