Chapter

8 CONTROL AND CO-ORDINATION

Control and Coordination in Animals

- Achieving higher organization of the body structure and equally high grade of functions the animals require greater coordination of activities. For receiving sensory inputs (stimulus) as external and internal change and to respond accordingly, nervous system has undergone the highest degree of change during evolution. It provides a rapid and spontaneous means to regulate and coordinate the changes in and around the body.
- The nervous system in animals consists of nerve cells and glial cells. Nerve cells are concerned with propagation of sensory information to the brain and motor information to the effector organs/cells. They are assisted in their function by glial cells.

Control and Coordination in Humans

Human Nervous System

- The nervous system of man consists of two parts : the **Central Nervous System (CNS)** including brain and spinal cord, **Peripheral Nervous System (PNS)** including a series of nerves (cranial and spinal nerves) which link CNS with various organs and **Autonomic Nervous System (ANS)** which includes sympathetic and parasympathetic nervous system.

1. Central Nervous System

(A) Brain : It is guarded by three meninges – pia mater, duramater and arachnoid mater.

Broadly the human brain is divided into three parts (i) forebrain (ii) Midbrain (iii) Hind brain

(i) Fore brain: It is divided into cerebrum, olfactory lobe and diencephalon.

(a) Cerebrum

- It also has a separate area of association which interpretes the information already stored in brain.
- It has motor area which control the movement of voluntary muscles like, leg muscle.

- The largest part of brain, remains divided by **median fissure** into two halves called cerebral hemispheres. It is a centre of memory, intelligence and various other functions.
- It is specialized for hearing, smell, sight and so on.

(b) Hypothalamus

- It is part of diencephalon.
- It is the site of hunger, thirst, appetite and emotions.

(ii) Mid Brain

- It is a small part of the brain mostly covered by cerebrum.
- It mainly consists of dorsal **optic lobes**. There are four small solid lobes referred to as **corpora quadrigemina**.
- The anterior pair of optic lobes are called **superior colliculi** while the posterior pair of lobes are regarded as **inferior colliculi**.

(iii) Hind Brain

- It is the posterior most part of the brain and continues as spinal cord, outside the cranium. It consists of following parts :

(a) Cerebellum

- It is also called as **small brain** and constitutes about 1/8th of the size of cerebrum which is situated below occipital lobe of cerebrum.
- It is responsible for precision of a voluntary actions and maintaining the posture and balance of the body.

(b) Pons Varoli

- It is situated on ventral side of the cerebellum, made of thick bundle of fibres.
- It carries impulse from one hemisphere of cerebellum to other.

(c) Medulla Oblongata

- It is the posterior most part of the brain with large number of sensory and motor nerve connections.
- It controls the involuntary action including blood pressure, salivation and vomiting.
- It extends to form spinal cord.

2. Peripheral Nervous System (PNS)

- PNS comprises of nerves originating from the CNS and spinal cord respectively and innervating different parts of the body *i.e.*, cranial and spinal nerves.

- Each nerve is composed of many nerve fibres enclosed within a connective tissue sheath. A nerve fiber is a long axon or dendrite of a neuron.

(a) Cranial Nerves

- Nerves originating from and terminating into brain are called cranial nerves.
- In man, there are 12 pairs of cranial nerves which pass through foramen magnum and mainly supply the peripheral tissues in the head.

(b) Spinal Nerves

- These nerves originate from the spinal cord and innervate to various parts of the body.

(B) Spinal Cord

- It is a cylindrical, cord-like, uniform extension of medulla oblongata, (42 – 45 cm. long in man) runs from neck to lumber region through the neural canal of vertebral column.
- It forms reflex arc and responsible for reflex action.

Reflex Action

- It is the spontaneous, involuntary and immediate response generated at the unconscious level stimulated through specific receptors.
- The sensory impulse is directly and automatically converted into a motor effect through CNS e.g., touching the lower limb of a decapitated frog with acid soaked cotton causes withdrawal of limb.

Endocrine System in Human

➢ **Endocrine system** in association with nervous system function in a coordinated way to maintain homeostasis. Endocrine system consists of endocrine glands and their respective hormones. Endocrine glands are effector organs, in that they are under the control of nervous system either directly or indirectly.

Hormone

➢ Hormone is the biologically active organic substance which acts as chemical messenger to alter the metabolic processes of target cells.

(1) Pituitary gland

- It is a small red-grey gland, lies in the sella turcica (bony depression found in base of skull) of the sphenoid bone.
- Pituitary gland secretes many hormones like; growth hormone that regulates growth and development of body.

- Its deficiency in children causes dwarfism.

(2) Thyroid gland

- It is the largest endocrine gland.
- Thyroid gland is located in the neck just below the larynx.
- It secretes thyroxine hormone.
- It regulates metabolisms of carbohydrates, fats and proteins.
- Thyroxine deficiency causes goiter.

(3) Adrenal Gland

- Adrenal glands are two small yellowish gland located superior to kidney (hence called supra-renal glands).
- Each adrenal gland, structurally and functionally divided into two main regions; outer cortex and inner medulla.
- The adrenal gland secretes a hormone called epinephrine or adrenaline. Adrenaline is the emergency hormone as it is secreted under great physical or emotional stresses like excitement, fear etc. Adrenaline increases the blood pressure, heartbeat, rate of respiration etc.

(4) Pancreas

- It is the second largest gland.
- It is heterocrine gland.
- The pancreas helps in regulation of blood sugar level.
- The pancreas secretes three hormones glucagon (α-cells), insulin (β-cells) and somatostatin (δ-cells).

(5) Ovaries

- Ovaries have two functions : production of mature ova and the secretion of female sex hormones – oestrogen and progesterone.
- Oestrogen regulates the development of the secondary sexual characters of the female at puberty.

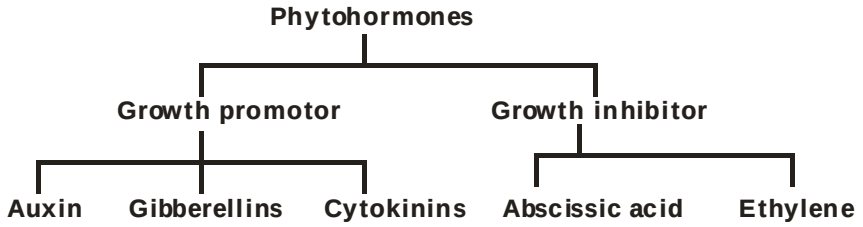
(6) Testes

- Like ovaries, the testes also have two functions : the production of sperms and the secretion of the male sex hormone, the testosterone.

Control and Coordination in Plants

Plants co-ordinate their behaviour against environmental change by using hormones. Plant hormones or phytohormones are synthesized by the plant in very small quantities. Plant hormones are also known as growth factor/growth hormones/ growth regulators etc.

The five major types of plant hormones which are involved in the control and coordination in plants are:



Growth Promotor

- **Auxin :**
  - It helps in cell division.
  - It shortens the plant internode.
  - It helps in root initiation.
  - Apical dominance and dormancy.
- **Gibberellins :**
  - Stem elongation.
  - Promotes flowering.
  - Breaks dormancy.
- **Cytokinins :**
  - Cell-division and cell elongation.
  - Morphogenesis
  - Induction of flowering.

Growth Inhibitor

- **Abscissic Acid :** It has following physiological effects
  - It causes senescence of leaves i.e. promotes leaves fall.
  - It inhibits seed germination.
- **Ethylene :**
  - It promote the ripening of fruits.
  - It inhibits elongation of stems and roots.

Plant Movements

- Plants exhibit only chemical co-ordination.
- Plants response against stimuli.
- The growth, control and co-ordination in plants is regulated by certain chemicals i.e., plant hormones.

  Plants show two different types of movements :

  (i) Movement dependent on growth (Tropic Movements)

  (ii) Movement independent of growth (Nastic Movements)

Nastic Movements.

- The movements that are independent of growth, response immediately to stimulus.

- In some plants like chhui-mui ('touch me not'), the leaves begin to fold up or droop after we touch the leaves.

Tropic Movements.

- The movements that are dependent of growth, response slowly to stimuli in a particular direction.
- Tropic movements are of following types :

(i) Phototropism (ii) Geotropism

(iii) Hydrotropism (iv) Chemotropism (v) Thigmotropism

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SOLVED QUESTIONS

1. (i) Differentiate between sensory neurons and motor neurons.

(i) How is brain protected in our body?

(iii) Name the part of the brain responsible for precision of voluntary actions and maintaining body posture and balance of the body.

Ans. (i) Sensory neurons carry impulses from receptors to the brain whereas motor neurons carry impulses from brain to the effectors (muscle/glands).

(ii) The brain is kept inside a bony box i.e., skull or cranium. Inside the skull the brain is enveloped by three protective membranes called meninges which is filled up with a fluid called cerebro spinal fluid.

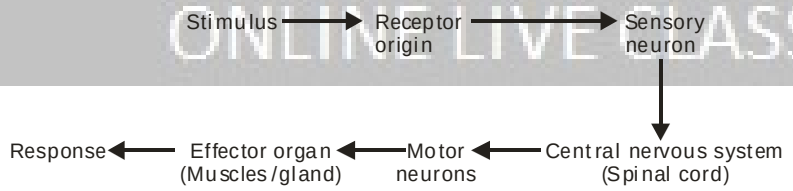
(iii) Cerebellum is the part of the brain responsible for precision of voluntary actions and maintaining body posture and balance of the body.

2. (i) What is reflex action?

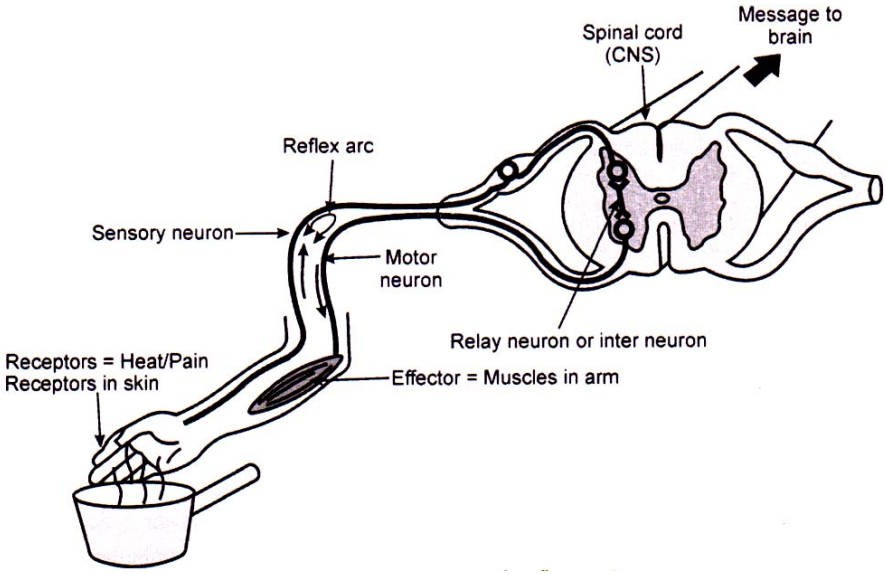
(ii) Describe the mechanism of reflex arc with the help of suitable diagram.

(iii) What is the significance of reflex action?

Ans. (i) Reflex actions are involuntary, instantaneous response to a stimulus perceived from the environment. Examples of reflex action are salivation when food is eaten, wider opening of pupil in dimlight and so on. Its components are



(ii) Withdrawl of hand after coming in contact with hot surface, thorn or needle is an example of spinal reflex arc. Sensation is received by receptors present in skin. It is passed through sensory neuron which then reaches to spinal cord. In the spinal cord the impulseis transferred to motor neuron by relay neuron. Motor neuron then passes the message to the effector i.e., the muscles of the arm. In response to this information the muscles move the hand away.



Reflex Arc

(iii) (a) It plays vital role in the survival of the animal.

(b) It relieves the brain from maximum strain.

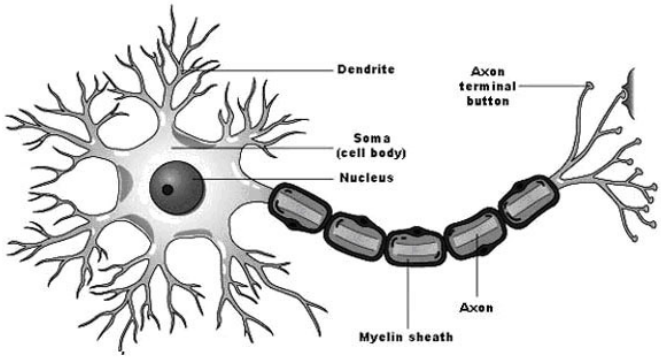
(c) It protects the animals from harmful situation by immediate response.

3. What are hormones?

Ans. Hormones are secretions of endocrine glands that are directly poured into the blood stream. They are required in small quantities which are translocated to a specific target region for inducing a physiological response.

4. Draw a well labelled diagram of a neuron

Ans.



5. List the functions regulated by forebrain.

Ans. (i) The forebrain is the main thinking part of the human brain.

(ii) It has association centres for hearing, smell, sight, hunger, thirst, touch, pain, sleep, emotions.

(iii) It also aids in movement of voluntary muscles.

(iv) The forebrain also stores the information. The different sensory informations are integrated and interpreted on the basis of all inputs and information stored in the brain.

6. Differentiate between sensory neuron and motor neuron.

Ans.

Differentiation between sensory and motor neuron.

Sensory Neuron	Motor Neuron
• A neuron that picks up sensation from the receptors and transmits the same to other parts like central nervous system.	• A neuron that carries message to the muscle, gland or an organ to perform its function.
• It conducts impulses towards central neuron system.	• It carries impulses away from central nervous system.

7. What causes tendril to encircle or coil around the object in contact with it? Explain the process involved.

Ans. The tendrils are spiral, wiry structures that are sensitive to touch. As these tendrils come in contact with support, the auxin present at the tip diffuses towards the other side away from the support. So this part grows more rapidly than the region which is towards the support. This is the reason why tendrils circle around the support and climb upwards.

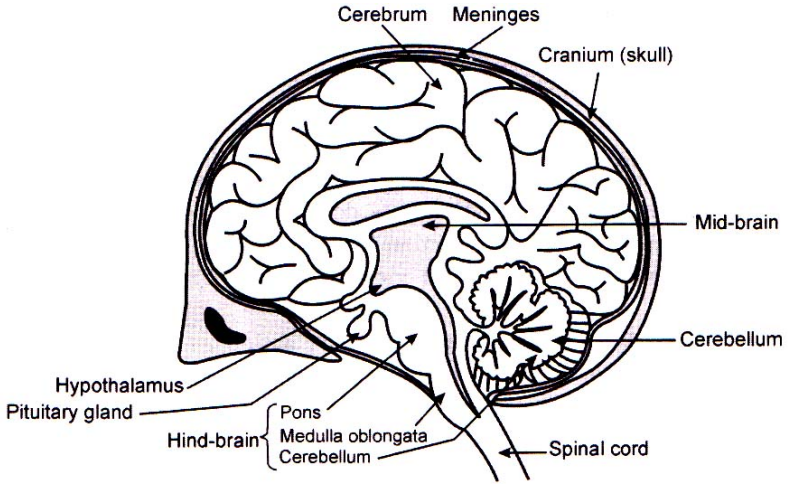
8. Draw a well labelled diagram of human brain with following parts :-

(a) Cerebrum (b) Cerebellum

(c) Medulla (d) Hypothalamus

(e) Cranium (f) Mid-brain.

Ans.



9. How does feedback mechanism regulate the hormone secretion? Explain with the help of an example.

Ans. Feedback system is a regulatory mechanism in which presence of certain level of hormone promotes or inhibits its further formation.

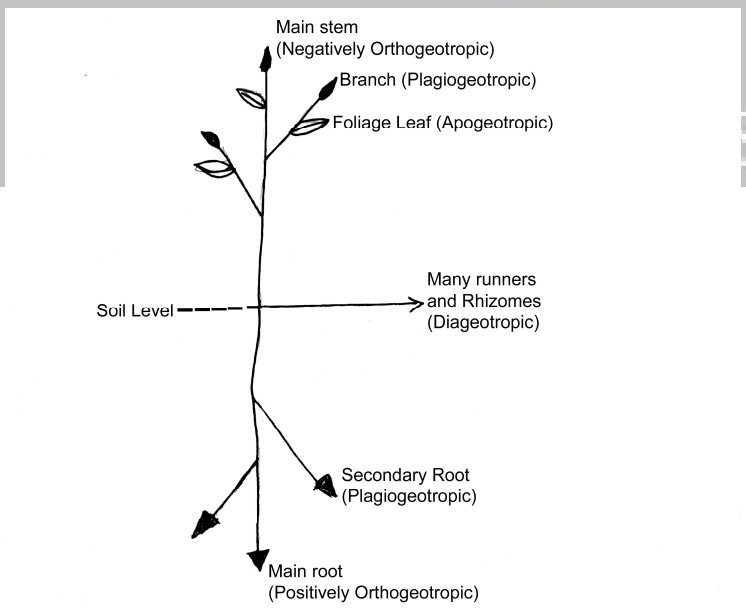
Regulation of thyroxine production by its concentration in blood is an example of hormonal feedback system. If the level of thyroxine is more in the blood, this is detected by hypothalamus, which stops producing thyroid stimulating hormone (TSH). Non-availability of TSH results in failure of thyroid to produce thyroxine. This automatically results in reduction of thyroxine in blood.

But if concentration of thyroxine is low in the blood, hypothalamus produces TSH which then passes into circulatory system and reaches thyroid gland. Thyroid now begins to secrete more thyroxine.

10. Name the plant growth hormone which is synthesized at shoot tip. Explain with the help of a diagram why does a plant bend towards light during growth.

Ans. (i) Auxin is a phytohormone which is synthesized at shoot tip.

(iii) When a plant is exposed to light coming from one side of the plant then auxin located at the shoot tip diffuses towards the shaded side of the shoot. High concentration of auxin in the shaded region stimulates the cells to grow longer in comparison to the region exposed to light. So the shoot tends to bend towards the light.



Various parts of a plant to the stimulus of gravity

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EXERCISE

NCERT QUESTIONS

Pick (√) out the correct option :

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?

LEVEL-I

1. What is the structural and functional unit of nervous system ?

2. What is main difference between tropic movements and nastic movements?

3. Which is the most complex and specialized part of the brain ?

4. Name the membranes which protect the brain.

5. Name some common functions of nervous system and endocrine system.

LEVEL-II

1. What will happen if intake of iodine in our diet is low?

2. What are sense organs? Give the various types of sense organs present in animals.

3. What is meant by homeostasis ? How is it achieved?

4. What is cerebrospinal fluid? What is its function?

5. State the functions of following hormones :

(i) Giberrellin (ii) Adrenaline

LEVEL-III

1. How does sense organs function in our body ?

2. Give differences between the endocrine and nervous control.

3. Name the various parts of hind brain and give their function also.

4. What is a synapse ? Why synapses are important ?

5. What are phytohormones ? What are their various functions.

6. Draw a labelled diagram of a neuron. Give its structure and also explain how it conducts nerve impulse.

7. Name the major types of plant hormones. Give at least one function of each plant hormone.

MULTIPLE CHOICE QUESTIONS

Pick (√) out the correct options :

1. A doctor advised a person to take an injection of insulin because

(a) his blood pressure was low (b) his heart was beating slowly

(c) he was suffering from goiter (d) his sugar level in blood was high

2. The main function of abscisic acid in plants is to

(a) increase the length of cells

(b) promote cell division

(c) inhibit growth

(d) promote growth of stem

3. Which of the following is not associated with growth of plant?

(a) Auxin (b) Gibberellins

(c) Cytokinins (d) Abscisic acid

4. Iodine is necessary for the synthesis of which hormone?

(a) Adrenaline (b) Thyroxin

(c) Auxin (d) Insulin

5. Choose the incorrect statement about insulin

(a) It is produced from pancreas

(b) It regulates growth and development of the body

(c) It regulates blood sugar level

(d) Insufficient secretion of insulin will cause diabetes

6. Select the mis-matched pair

(a) Adrenaline : Pituitary gland

(b) Testosterone: Testes

(c) Estrogen : Ovary

(d) Thyroxin : Thyroid gland

7. 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

8. 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

9. The growth of pollen tubes towards ovules is due to

(a) hydrotropism (b) chemotropism

(c) geotropism (d) phototropism

10. The movement of sunflower in accordance with the path of sun is due to

(a) phototropism (b) geotropism

(c) chemotropism (d) hydrotropism

11. The substance that triggers the fall of mature leaves and fruits from plants is due to

(a) auxin (b) gibberellin

(c) abscisic acid (d) cytokinin

12. Which of the following statements about transmission of nerve impulse is incorrect?

(a) Nerve impulse travels from dendritic end towards axonal end

(b) At the dendritic end electrical impulses bring about the release of some chemicals which generate an electrical impulse at the axonal end of another neuron

(c) The chemicals released from the axonal end of one neuron cross the synapse and generate a similar electrical impulse in a dendrite of another neuron

(d) A neuron transmits electrical impulses not only to another neuron but also to muscle and gland cells

13. Involuntary actions in the body are controlled by

(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?

(a) Vomiting (b) Salivation

(c) Heart beat (d) Chewing

15. When a person is suffering from severe cold, he or she cannot

(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. Which statement is not true about thyroxin?

(a) Iron is essential for the synthesis of thyroxin

(b) It regulates carbohydrates, protein and fat metabolism in the body

(c) Thyroid gland requires iodine to synthesise thyroxin

(d) Thyroxin is also called thyroid hormone

17. Dwarfism results due to

(a) Excess secretion of thyroxin

(b) Less secretion of growth hormone

(c) Less secretion of adrenaline

(d) Excess secretion of growth hormone

18. Dramatic changes of body features associated with puberty are mainly because of secretion of

(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

QUESTIONS BASED ON HIGH ORDER THINKING SKILL

1. There are various growth promoting chemical synthesized by meristematic tissue at the tip of stem (or root). Chemical A is also one of them. This chemical is

responsible for phenomenal B in plants in which the stem bends towards sunlight. The same chemical X has an opposite effect on the root of plants. This causes the root of plants to bends away from the sunlight in a process C.

(i) What is the name of chemical A?

(ii) State whether A prefers to remain in sunlit side of a stem or in shade.

(iii) State the effect of A on the rate of growth of

(a) A root (b) A stem

(iv) What is the name of the processes B and C.

(v) What is the general name of chemicals like A? Name another chemical which belongs to this growth promoting groups.

2. A, B, C and D are four major types of phytohormones. A is a phytohormone which functions mainly as a growth inhibitor. It promotes the wilting and falling of leaves. B, C and D are phytohormones that all promote growth of plants in various ways. It is responsible for the phenomenon of phototropism in plants. C is involved mainly in shoot extension. The phytohormone D helps in breaking the dormancy of seeds and buds. What are A, B, C and D?

3. Name the hormones and their source glands which shows following physiology

(i) Growth in fore limbs and hind limbs.

(ii) Its deficiency causes goiter

(iii) Lowers the blood glucose level.

(iv) Regulates calcium and phosphates in blood.

(v) Helps in regulation of male's puberty and in female regulates female's puberty.

4. The gland A which is located just below the brain in the human head secretes a chemical substance B which controls the development of bones and muscles in the body of a person. Secretion of too little substance B as well as the secretion of too much of substance B by the gland A leads to abnormal development of the body of a person.

(i) Name the gland A.

(ii) What is the chemical substance B.

(iii) What happens if two little of substance B is secreted?

(iv) What happens if too much of substance B is secreted?

(v) Name the system of glands in human body of which gland A is a part.

5. X is a cell (group of cells) in the human body which receives a particular type of stimulus and conveys its message to CNS through nerve Y. On the other hand Z

is another nerve which conveys response to effector organ. Name fie organs which contains cells like A.

(i) Name the nerve Y.

(ii) What is the role of Y?

(iii) Name nerve Z.

(iv) What is A?

(v) How the message 'travel through the names Y and Z?

VALUE BASED QUESTIONS

1. Akash's grand father was not feeling well. He went to a physician who after examining him told, his blood urea level is high and advised him to undergo 2 – 3 days regular dialysis.

(i) What happens with Aakash's grand father?

(ii) Why does physician called him for dialysis? How dialysis is performed?

(iii) Is there any other remedy that can help to avoid Akash's grand father regular dialysis.

2. A person made an accident at highway. A hospital 2 km away from the place of accident. People admitted the injured person in the said hospital. Doctor adviced that this person needs immediate transfusion of blood. After some hours the team of doctors found that there is internal injury and there is lack of blood clotting factor :

(a) What type of blood should be transfused to patient immediately.

(b) What type of blood group is also need to transfuse to the injured person.

3. A person used knife and circumferentially removed the bark of small tree. A few days later he found that the roots of plant dries up

(i) What does he observed?

(ii) Why does the roots of plant dries up first.

(iii) Which tissue is responsible for conduction of food in plants.

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WORKSHEET - 1

1. What do you mean by “Tropic Movements” in plants?

2. Names the different types of tropic movements in plants?

3. Differentiate between the ‘Phototropism’ and ‘Geotropism’.

4. Differentiate between the chemotropism and Thigmotropism.

5. Differentiate between the Tropic movements and Nastic movements?

6. Name the different types of phytohormones and mention their role in plant growth?

WORKSHEET - 2

1. How does chemical coordination take place in animals?

2. Define 'hormones' and name the a few hormone secreted from various endocrine glands of human body?

3. Give the characteristics of hormones.

4. Name the hormones released by the following with specific functions :

(a) Ovary (b) Testis

(c) Pancreas (d) Pituitary

(e) Thyroid gland

5. What is the role of adrenaline hormone that is secreted and released in the blood?

6. Draw a diagram of human (male and female) hormonal system.

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WORKSHEET - 3

1. Draw a well labelled diagram of the structural and functional unit of nervous system.

2. Compare between the nervous and hormonal mechanism for control and co-ordination.

3. How do neurons transmit information?

4. What is reflex action? Describe the steps involved in a reflex action.

5. What do you mean by reflex Arc? Draw a well labelled diagram of a action in reflex arc?

WORKSHEET - 4

1. Draw a well labelled diagram of a brain.

2. What is the need for a system of control and coordination in an organism?

3. Give the tabulate form of Nervous system?

4. Give the composition of fore-brain and describe its specific functions.

5. What is the function of spinal cord and where it is situated?

6. What are the three parts of the hind-brain? Specifying their important functions.