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# CONTROL AND COORDINATION

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All living organisms including plants and animals respond and react to environmental factors or stimuli. There is necessity to develop some system for control & coordination of various body organs. In multicellular organisms, specialized tissue is used for control & coordination activities. Control & coordination in animals are provided by nervous & muscular tissues. Chemical coordination is seen in both plants and animals.

## NERVOUS SYSTEM:

It is the system of conducting tissues that receives the stimulus and transmits it to other parts of the body forming a network.

- The nervous system comprise of – Neurons, Nerves and Nervous organs which controls, link & coordinate activities of different organs of the body.
- Vertebrate Nervous System consists of Three parts-
  1. Central Nervous System (CNS): Includes Brain & Spinal cord.
  2. Peripheral Nervous System (PNS): Includes Peripheral Nerves (Nerves which originate from CNS i.e. Brain & spinal cord).
  3. Autonomic Nervous System (ANS): Includes Autonomic Nerves (Nerves which originate from peripheral nerves & spinal nerves).

Function of Nervous system:-

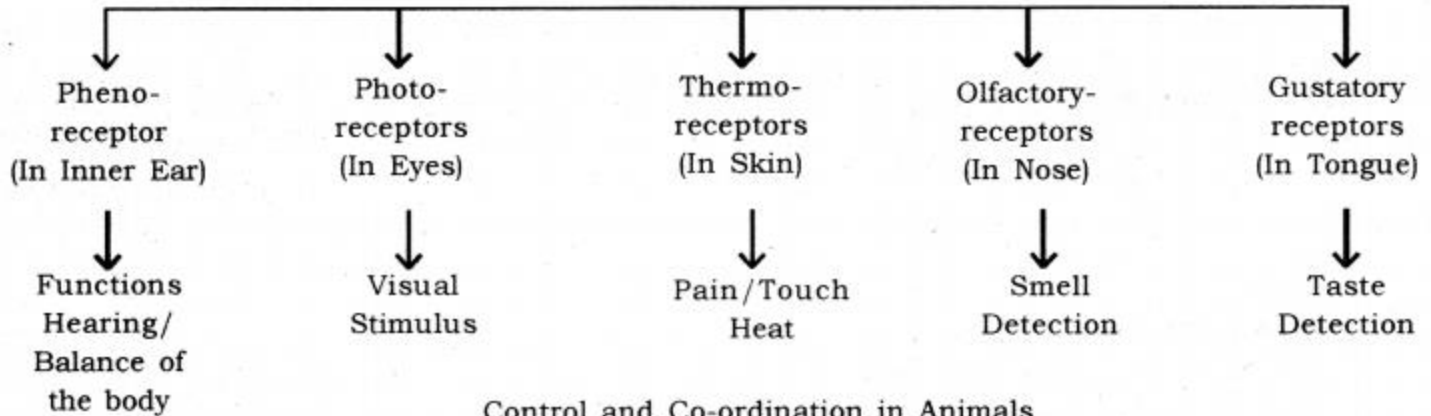
1. It regulates involuntary action (Action which are not controlled by our Will).
2. It controls and coordinates voluntary muscular activities.
3. It enables us to think reason & remember.
4. It controls all reflex actions in our body thus protecting it from harm.

**RECEPTER:** it is a cell or group of cells specialized to detect particular stimulus and to initiate the transmission of impulse via the sensory nerves.

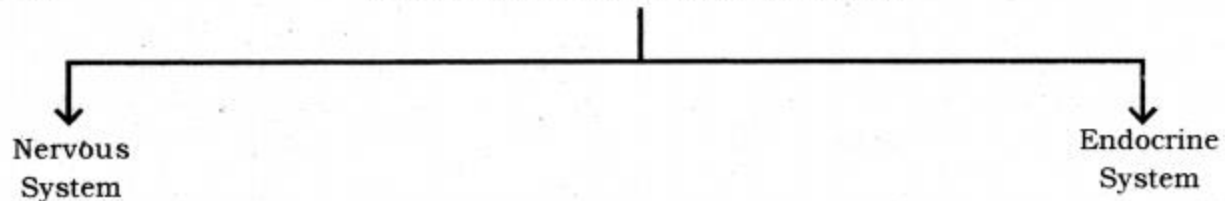
E.g.-

SL. NO.	RECEPTOR	STIMULUS	ORGAN
1	Photoreceptor	Light	Eye
2	Phonoreceptor	Sound	Ears
3	Gustatoreceptor	Taste	tongue
4	Olphactotoreceptor	Smell	Nose
5	Thigmoreceptor	touch	Skin

### Receptors are Sense Organs



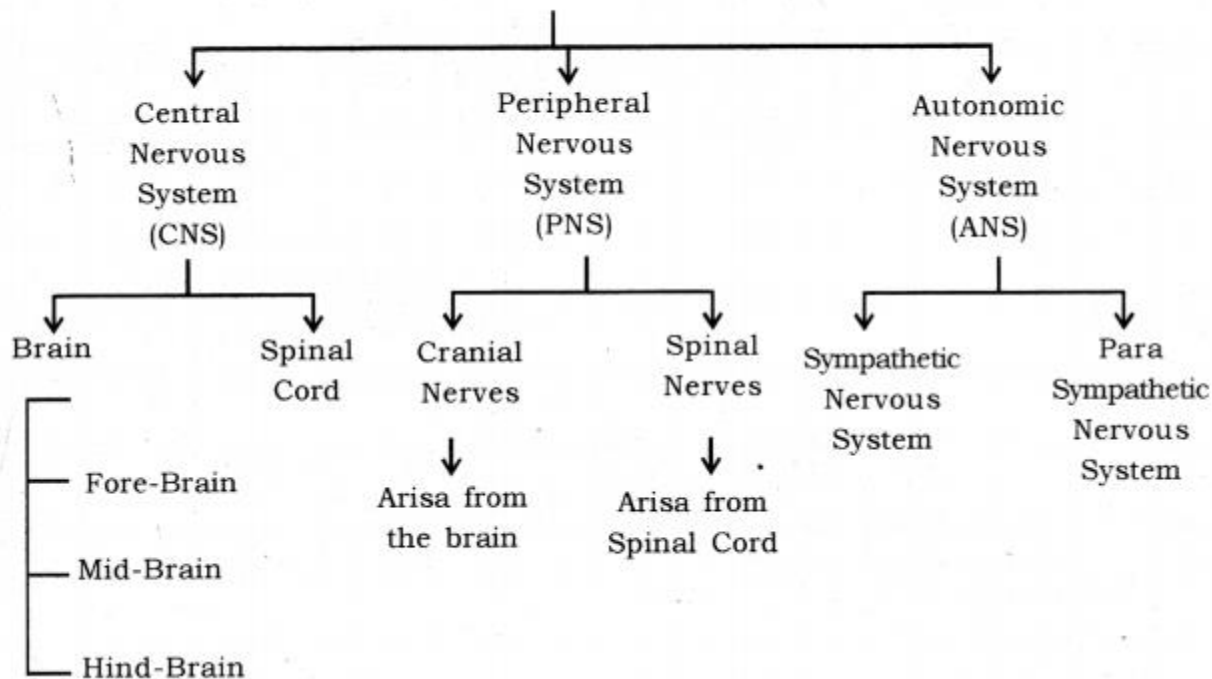
### Control and Co-ordination in Animals



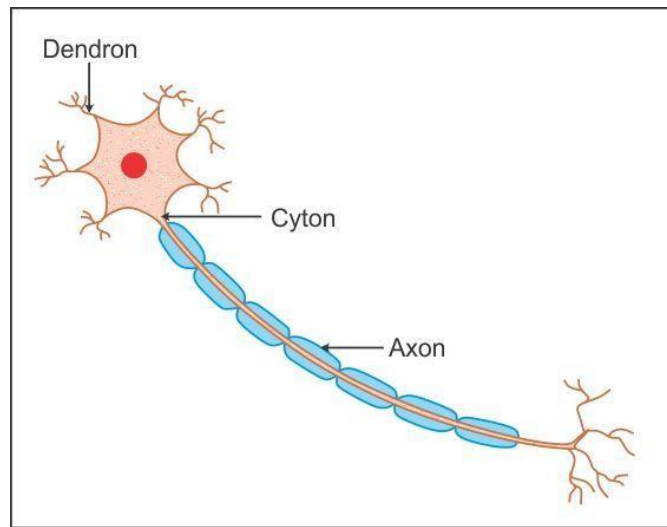
### UNIT OF NERVOUS SYSTEM: NERVE CELLS/ NEURONS:

- Neurons are the longest cell of animal body.
- Neuron does not divide after its formation because of longer length and lack of centriole.
- About 12 billion neurons are in human body. The highest number of nerves cells is found at the time of our birth.

### Human Nervous System



## STRUCTURAL DETAIL OF NEURON:-



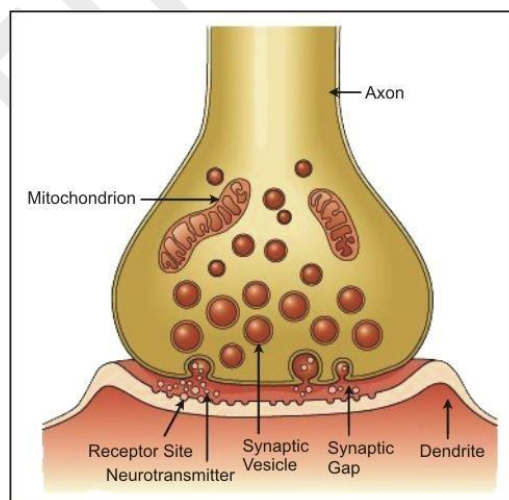
The three main parts of a neuron are:

- Cell Body- It has a well defined nucleus and granular cytoplasm.
- Dendrites- Dendrites are branched cytoplasmic projections of the cell body.
- Axon- It is a long process of the cell body. The end portions of the axons have swollen bulb-like structures which store neurotransmitters.

Function of neuron: - Formation and Conduction of Nerve impulse

### SYNAPSES:

Association of neurons i.e. Junction between the associated neurons or nerves cells i.e. Between axon ending of one neuron and the dendrite of the next. (was discovered first by sir charles sherrington, who is called father of modern neurophysiology)



**NERVE IMPULSE:** - it is the information in the form of chemical and electrical signals passing through neurons.

“It can be defined as Physiochemical (due to formation) Message ( due to conductive activity) of Electrical ( due to wave like

conduction) activity.

- Nerve impulse is considered as Secret of life.
- Nerve impulse is formed due to potential difference inside and outside the cell membrane of nerve cells due to Na and K ions.

**TYPES OF NERVES CELLS:** nerve cells are of Three types on the basis of direction of conduction of nerve impulse:-

1. Sensory (or Afferent) Nerve: Conduct nerve impulse from organs to the CNS i.e. towards CNS.
2. Motor (or Efferent) Nerve: Conduct nerve impulse from CNS to the Organs i.e. away from CNS.
3. Mixed nerve: Conduct nerve impulse both towards & away from the CNS.

**TRANSMISSION OF NERVY IMPULSE:**

The information acquired at the end of the dendrite tip of a neuron, sets off a chemical reaction which creates an electrical impulse. This impulse travel from a 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 chemical, which cross the Synapse and starts a similar impulse in a Dendrite of the next neuron. In this way nerve impulse travels in the body.

A similar synapse allows impulse from neurons to other cells such as muscle cells or glands.

**VOLUNTARY ACTION:** The actions which are in control of our will i.e. these actions need thinking and are preformed knowingly i.e. are controlled by conscious thought.

E.g. - Speaking to a friend, writing a letter etc.

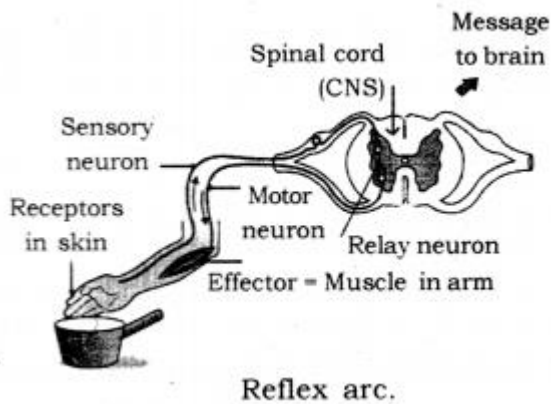
**INVOLUNTARY ACTION:** these are not under the control of the will of an individual and are automatic response to astimulus.

e.g. - Touching of a hot plate unknowingly.

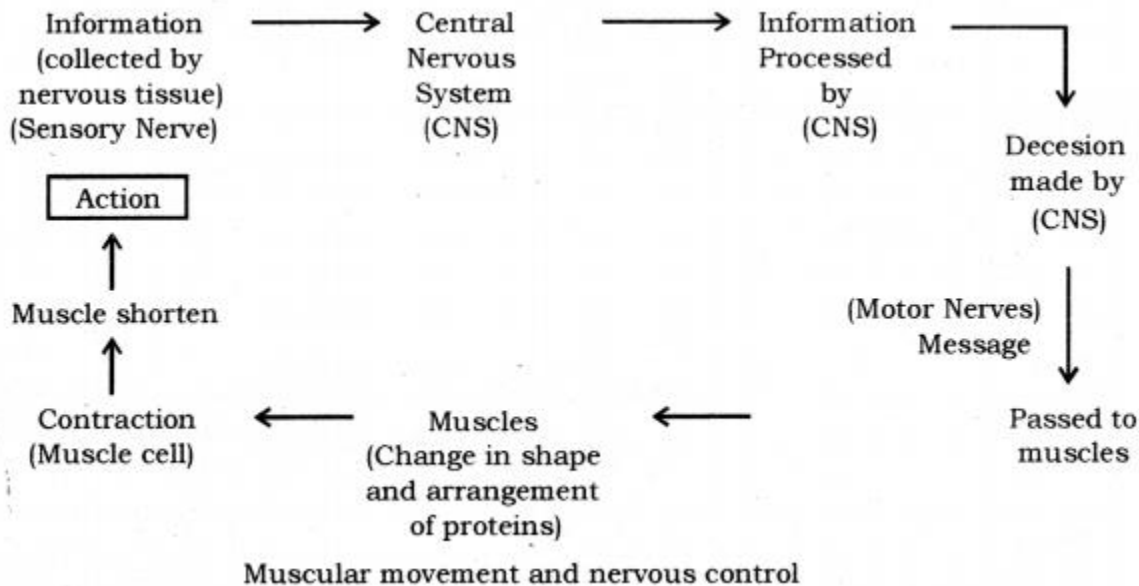
**REFLEX ACTION:** it is the intermediate (or instant) involuntary and unconscious response to a stimuli. It is controlled by CNS(except the Cerebrum) mainly by spinal cord.

Reflex appeared in animal world to relieve the brain from some of its responsibility.

**REFLEX ARC:** - represents the path through which the nerve impulse is conducted during reflex. It consists of Receptor,Sensory/afferent neuron, CNS, Motor/efferent neuron and Effector which can be either muscle or gland.



**Muscular Movements and Nervous Control:** Muscle tissues have special filaments, called actin and myosin. When a muscle receives a nerve signal, a series of events is triggered in the muscle. Calcium ions enter the muscle cells. It result in actin and myosin filaments sliding towards each other and that is how a muscle contracts. Contraction in a muscle brings movement in the related organ.



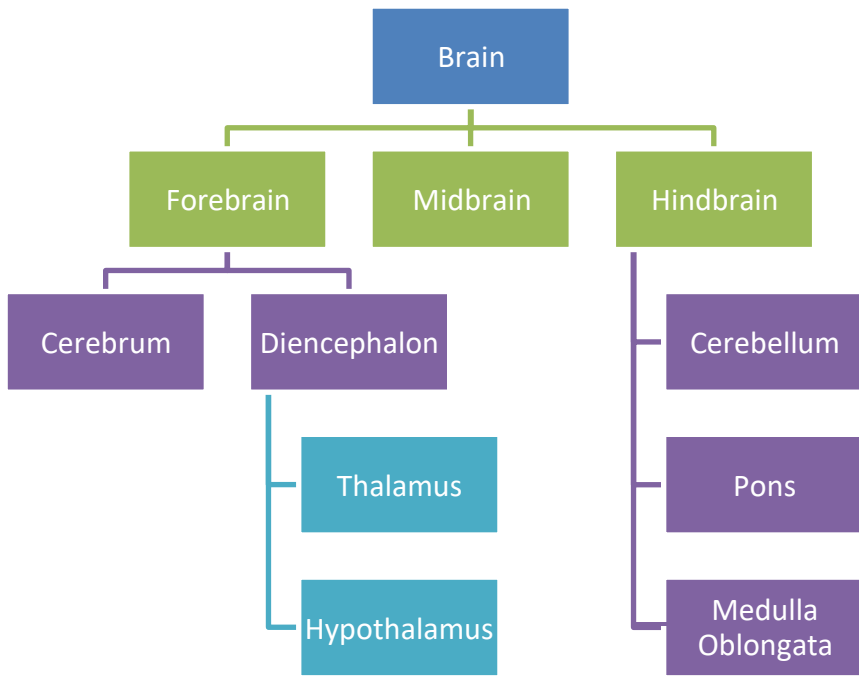
## **HUMAN NERVOUS SYSTEM:-**

**CNS (CENTRAL NERVOUS SYSTEM):** Consists of both Brain and Spinal cord.

The brain and spinal cord are protected by the Skeleton- Brain by the CRANIUM/BRAI BOX and Spinal cord by the VERTIBRAL COLUMN.

**BRAIN:** - It is the highest coordinating centre in the body. It is broadly divided into three regions:-

1. Fore brain-
  - a) Olfactory lobe
  - b) Cerebrum (2 cerebral hemisphere)
  - c) Diencephalon
2. Mid brain
3. Hind brain-
  - a) Pons
  - b) Medulla oblongata
  - c) Cerebellum



### **FUNCTION:**

#### **Cerebrum:**

1. Controlling of all voluntary activities of our body.
2. Detection of different types of senses like touch, smell, vision, chemical, temperature etc.
3. It is also considered as centre for intelligence, thought, memory and emotions.

To perform the above activities the cerebrum of man consist of different areas like Motor area, Pre-motor area, Somaesthetic area, Broca's area, werink's area, olfactory area, auditory area, visible area, association area.

#### **Diencephalon:**

1. secretes melatonin.
2. Formation and control of pituitary.
3. Centre for sleep, anger, hunger, pain, thrust, pleasure
4. Controls functioning of ANS.

**Mid brain:** Connects the fore brain to hind brain. it controls Reflex movement of the head , neck & trunk in response to visual and auditory stimulus

#### **Hind brain:**

**Pons:** regulates Rate of Respiration.

**Medulla oblongata:** lies at the floor of the hind brain and continues into the Spinal cord.

It is the centre for controlling all involuntary activities such as basic rhythm of respiration, heartbeat, peristalsis, digestion etc.

**Cerebellum:** Controls the coordination of the body movement and posture.

## **HORMONAL CONTROL IN ANIMALS**

**HORMONE:** (Gr. Hormain=to excite / to stirrup)

Hormone is the biogenetic organic material of low molecular weight secreted directly into blood in very little amount showing distant effect acting indirectly through either cell organelles or the enzyme system.

Hormones can be Amines, Proteins, Peptides & Steroids.

- Lord Barnad studied relationship between Nervous system and Endocrine gland.

Nervous action	Hormonal action
Occur by nerve impulse carried through Axon of Neuron.	Occur by chemicals carried through the blood.
Occur very fastly i.e. instantly.	Occurs slowly
Are short lived	Are long lived
Are highly specific	Are less specific.

**ENDOCRINE GLANDS & THEIR HORMONES IN HUMAN BEING:-**

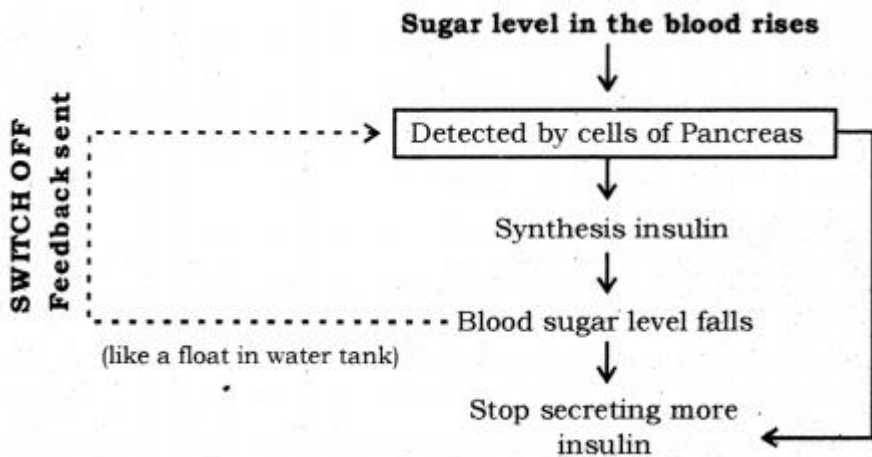


A) **PITUTORY GLAND/ HYPOPHYSIS:**

1. Growth hormone / somatotrophic hormone / somatotrophin:
2. Thyroid stimulating hormone (T.S.H)
3. Adrenocorticotrophic hormone (A.C.T.H)
4. Follicle stimulating hormone (F.S.H): in women it helps in growth and maturation of ovarian follicle, whereas in male it helps in spermatogenesis.
5. Leutinizing hormone (L.H)/interstitial cell stimulating hormone (ICSH): in female it helps in ovulation and formation of corpus leutium, whereas in male it stimulates Interstitial cell/ cells of Leydig of the testis to secrete male hormone-androgens e.g. - Testosterone.
6. Leuteotrophic hormone (L.T.H)/ Mamotrophic hormone/ Prolactin: helps in further growth of Corpus Leutium & secretion of more progesterone hormone.
7. Vasopressin/ Antidiuritic hormone: helps in retention of water in the body by increasing absorption of water from the urine through distal convoluted tubule and collecting duct. Resulting in production of hypertonic urine.
8. Oxytocin / Pitocin: it is secreted in female during the birth of the baby.

B) **THYROID GLAND:**

1. Thyroid hormone (T4 & T3): promotes physical and mental growth of our body, and also stimulates tissue differentiation especially in lower vertebrate and thus helps in metamorphosis of tadpole into frog.
2. Calcitonin: Regulates blood calcium level if it is somehow increased.



C) **ADRENAL GLAND:**

1. Secrete Minaralocorticoids: e.g.- Aldosteron
2. Secrete Glucocorticoids: e.g.- cortson, cortisteron, cortisol.
3. Sex Steroid/ sex hormones: e.g.- androgen in male & Estrogen in female.
4. Adrenalin/ Epinephrine
5. Nor-adrenalin/Nor- Epinephrine

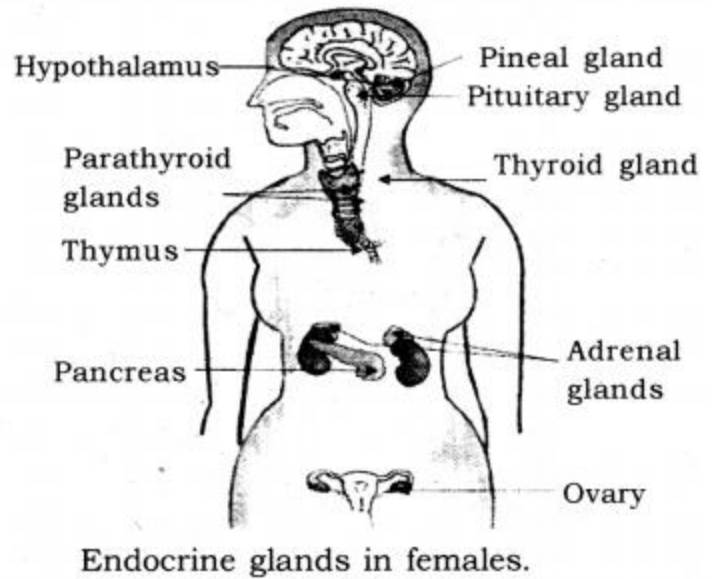
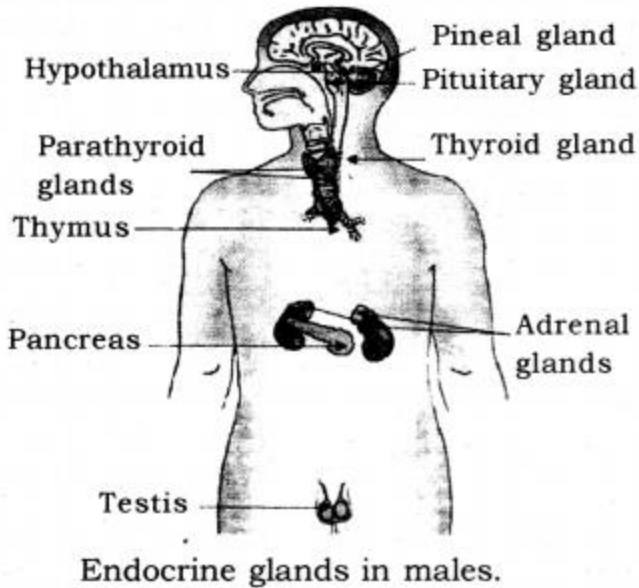
Both Adrenalin and Nor-Adrenalin are together called **CATCHOLAMINE** and has similar function.

1. Stimulate elevation of blood glucose by converting liver glycogen to glucose.
2. Rise in blood pressure.
3. Accelerate rate and force of Heartbeat.
4. Increase in oxygen consumption.
5. Erection of hair.
6. Dilation of pupil

## 7. Initiates stress response.

These hormones prepares individual for Fight, Flight & also Frighten, thus also called 3F hormone.

- D) **PARATHYROID**: Secrete PARATHORMONE:- helps in regulation of blood calcium level if it is somehow decreased.
- E) **THYMUS**: Secrete THYMOSIN: - helps in differentiation of T-Lymphocytes. PROGESTERON & ESTROGEN:- stimulate Uterine lining for embryo implantation to maintain pregnancy, prepare mammary gland for lactation and inhibits Ovulation.
1. RELAXIN: relax pubic symphysis & helps to dilate Uterine Cervix near the end of pregnancy.
  2. INHIBIN/ ACTIN:- inhibition / Activation of FSH & GnRH production.



## COORDINATION IN PLANTS

Animals have nervous system for controlling and coordinating the activities of the body. but plants have neither a nervous system nor muscles. So how they respond to stimuli.

The plants show two different types of movement- one dependent on growth e.g.- movement of tendrils of climber plants, and the other dependent on growth- e.g.- when we touch the leaves of the chhu-mui (Touch me not) they begin to fold up & drop.

Plants cell change shape by changing the amount of water in them resulting in swelling or shrinking, thereby changes the shapes.

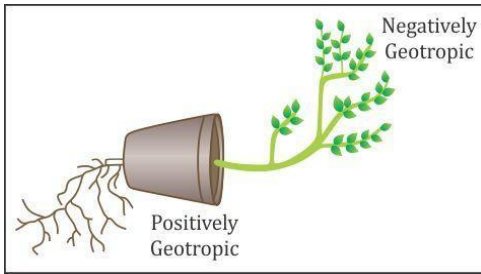
The movement of the individual plant part or organs of a plant like shoot , root etc. are due to some external stimuli like light, force of gravity , chemical substances , water etc.

The directional growth or movement of the plants organ in response to external stimuli is called Tropic movement. The growth towards the stimulus is +ve Tropism and away from the stimulus is –ve Tropism. Tropic movement is classified as follows depending on the type of stimulus causing it:

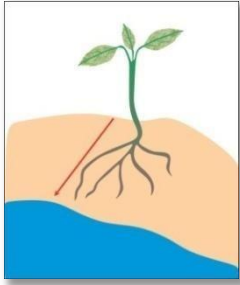
1. **PHOTOTROPISM:** is movement of a part of the plant in response to the light.



2. **GEOTROPISM:** is the upward or downward growth of shoots & roots in response to the pull of earth or gravity.



3. **HYDROTROPISM:** is the movement of the part of the plant in response to the water.



4. **Chemotropism:** is movement of a part of a plant in response to a chemical stimulus.



If the plant part shows movement or growth towards the chemical, it is called +ve chemotropism and if the plant part shows movement or growth away from the chemical, it is called -ve chemotropism.

e.g. - Growth of pollen tube towards a chemical which is produced by an ovule during the process of fertilization in flower.

The growth in plants is controlled by certain chemical substances known as HORMONES/ PHYTOHORMONES. It helps to coordinate growth, development & response to the environment. They are synthesized at places away from where they act and simply diffuse to the area of action.

The major types of plant hormones which are involved in the control & coordination in plants are follows:-

1. **AUXIN**: Is the group of plant hormones synthesized at the shoot tip of the plant body.  
Function:-
    - I. It promotes cell elongation, root formation, cell division, and flowering.
    - II. It plays an important role in development of seedless fruit.
    - III. It prevents premature fall of leaves.
  2. **GIBBERELLINS**:-  
Break genetic dwarfism i.e. Stimulates shoot elongation & flowering. The maximum concentration of gibberellins is found in fruits and seeds.
  3. **CYTOKININ**: - it includes all those organic compounds which have the capacity to stimulate cell division. Function:-
    - I. Stimulates cell division and leads to callus formation.
    - II. It promotes development of lateral buds thus lateral branching.
    - III. It delays the aging in leaves by checking the loss of chlorophyll and promotes the opening of stomata.
  4. **ABSCISIC ACID (ABA)**:-it is a growth inhibitor which reverses the growth promoting effects of Auxin & gibberellins. Function:-
    - I. It causes dormancy of seeds, tubers & bulbs.
    - II. It promotes the closing of stomata.
    - III. It causes wilting of leaves (leaf fall).
  5. **ETHYLENE**  
**NE**:-  
Function:-
    - I. It causes ripening of fruits.
    - II. It checks elongation of root & stem but cause lateral expansion.
    - III. It checks flowering (except Pine-apple).
    - IV. It causes seed dormancy.
    - V. It causes fall of flowers, leaves & fruits.
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