CONTROL & COORDINATION

INTRODUCTION

We have studied previously that life processes involved in the maintenance functions in living organisms.

We know that if we see something moving, it is alive.

Some of these movements are in fact the result of growth, as in plants.

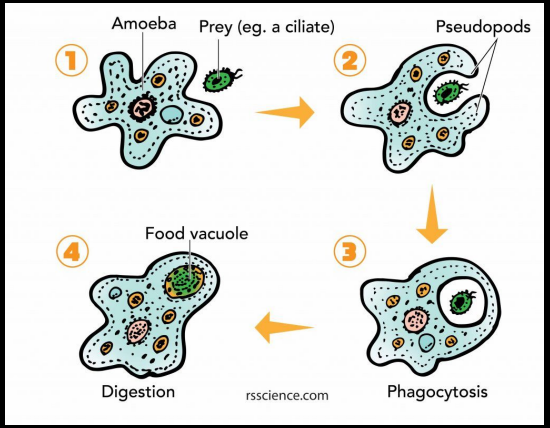
A seed germinates and grows, and we can see that the seedling moves over the course of a few days, it pushes soil aside and comes out.

But if its growth were to be stopped, these movements would not happen.

All living organism respond & react to changes in the environment. Animals have NEURAL SYSTEM and ENDOCRINE SYSTEM for generating the best response towards the stimuli. But Plants only rely on hormones for that.

STIMULI

The changes in the environmental conditions to which the organisms respond.



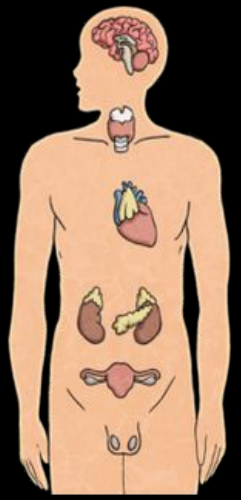
COORDINATION

The working together of the various organs of an organism in a systematic manner so as to produce a proper response to the stimulus.

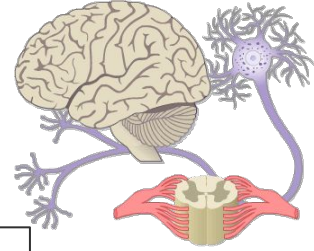
COORDINATION IN ANIMALS

2 MAIN SYSTEM OF CONTROL & COORDINATION IN HUMANS

NERVOUS SYSTEM



ENDOCRINE SYSTEM



NERVOUS SYSTEM

- Central Nervous System (CNS)
  - Brain
  - Spinal Cord
- Peripheral Nervous System (PNS)
  - Afferent Nerve Fibres
  - Efferent Nerve Fibres

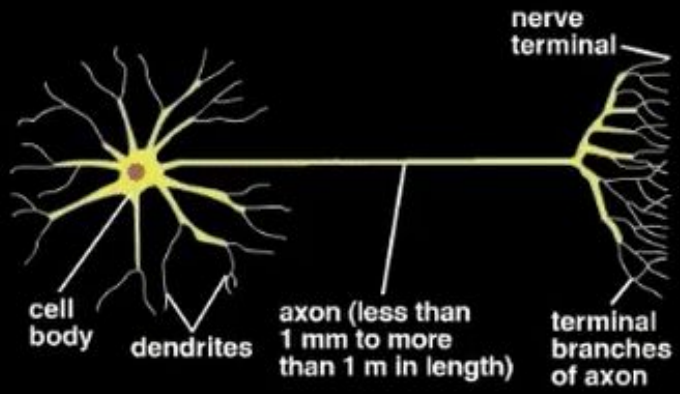
- The nerves given out by the brain and the spinal cord form the peripheral nervous system (PNS).
- There are 12 cranial nerves and 31 spinal nerves in humans.

It has three types of nerves:

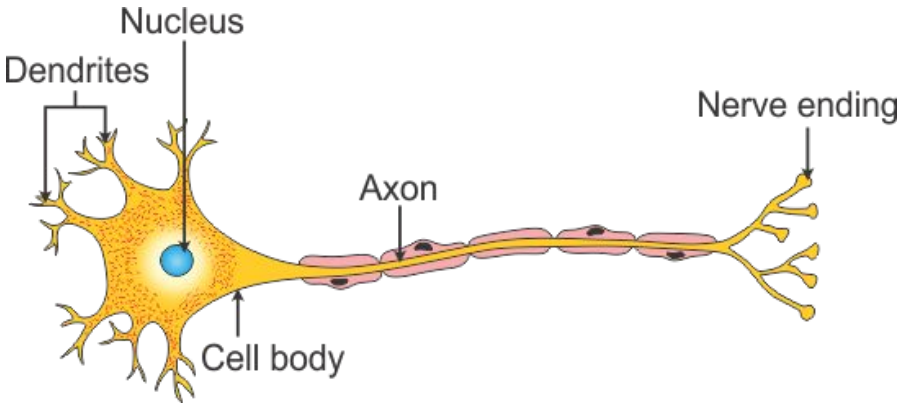
1) Cranial nerves: Connect all parts in the head to the brain
2) Spinal Nerves: Connect all remaining body parts to the spinal cord
3) Visceral Nerves: Connect internal organs of the body to the spinal cord (sometimes, to brain)

NEURONS

- Structural and functional unit of nervous system.
- Carry messages in the form of electrical signals called electrical impulses or nerve impulses.
- It is the longest cell in human body.



COMPONENTS OF NEURON



Cell Body- Cyton

Typical animal cell which contains cytoplasm & a nucleus.

Dendrites

The shorter fibres on the body of a neuron.

Axon

Longest fibre on the cell body of a neuron.

Has an insulating and protective cover of myelin around it (Myelin is made up of fat and protein).

	Receptor	Effector
DEFINITION	Receptor is a cell or a group of cells of a sensory organ which receives stimuli	Effector is a muscle or a gland that produces an action to a stimulus
MAIN ACTION	Senses receives the stimulus	Produces a response to the stimulus
TYPE OF STRUCTURE	A cell or group of cells of a sensory organ	Muscle or gland
PRESENT IN	Sensory organs	All over the body
INFORMATION	Sends information to the central nervous system	Receives commands from central nervous system

Sensory organs and Receptors

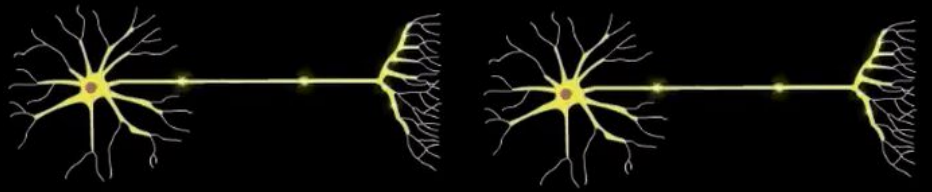
EAR	Phonoreceptors (receiving sound)
EYES	Photoreceptors (receiving light)
SKIN	Thermoreceptors (feels temperature)
NOSE	Olfactory receptors (sense of smell)
TONGUE	Gustatory receptors (sense of taste)

Receptor cells receive the information from our surrounding environment. This information acquired at the end of the dendritic tip of a nerve cell sets off a chemical reaction that creates an ELECTRICAL IMPULSE. This impulse then 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 pf the nearest neuron.

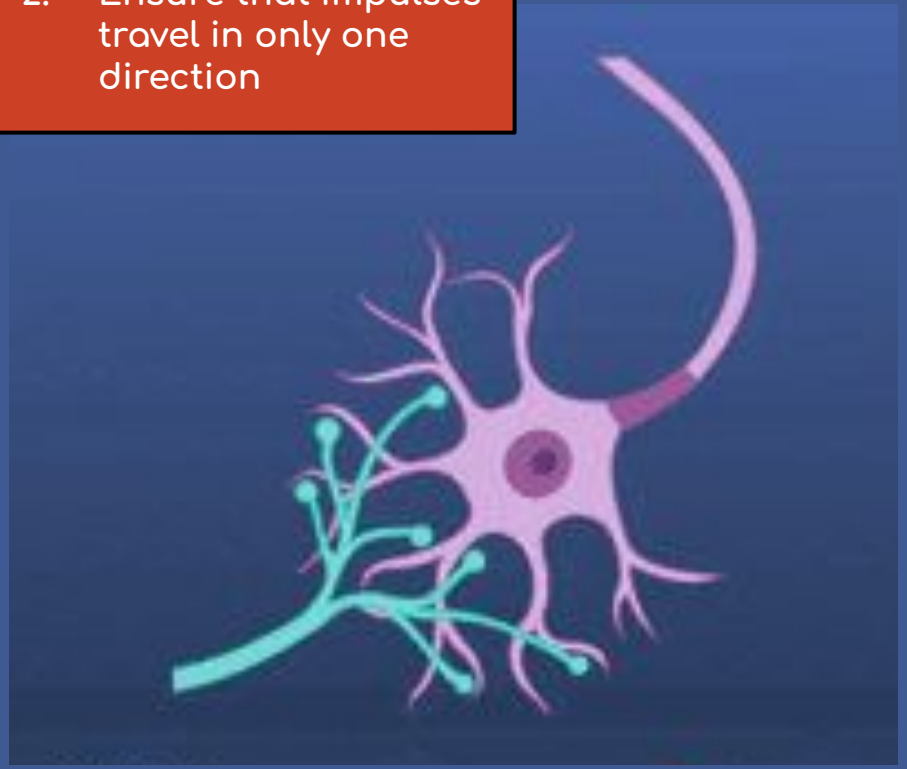
This is how nervous impulses travel in the body

So What happens when we touch a hot plate?



Synapses are:

1. One way Valves
2. Ensure that impulses travel in only one direction



Types of Neuron

1

Sensory Neuron

Transfer impulses from sensory cells to CNS.

2

Relay Neuron

Serves as link between sensory and motor neurons.

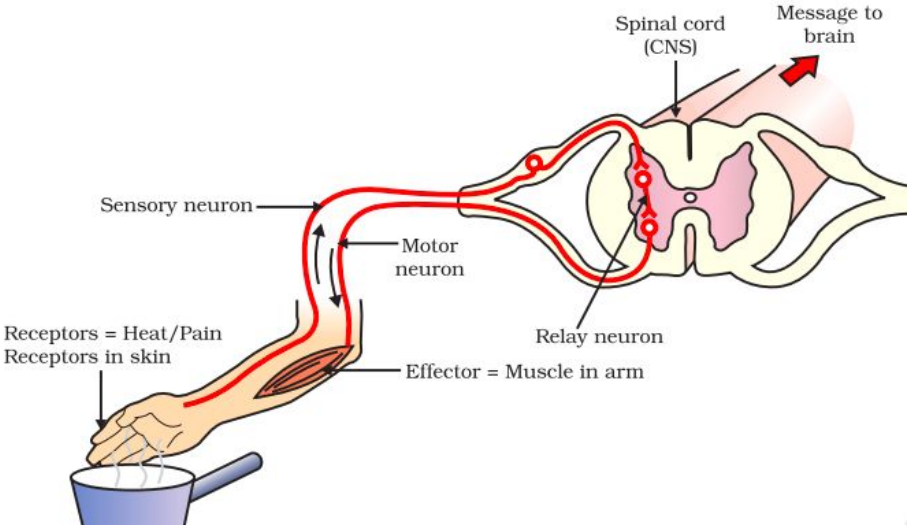
3

Motor Neuron

Transfer impulses from CNS to muscle cells.

What happens in Reflex Action?

REFLEX ACTION & REFLEX ARC



Reflex action is a sudden, involuntary reaction of the body in response to stimuli.

The pathway taken by nerve impulses in a reflex action is called the reflex arc. Reflex arc allow rapid response.

How does the Nervous Tissue cause Action?

Muscle cells have special proteins that change both their :

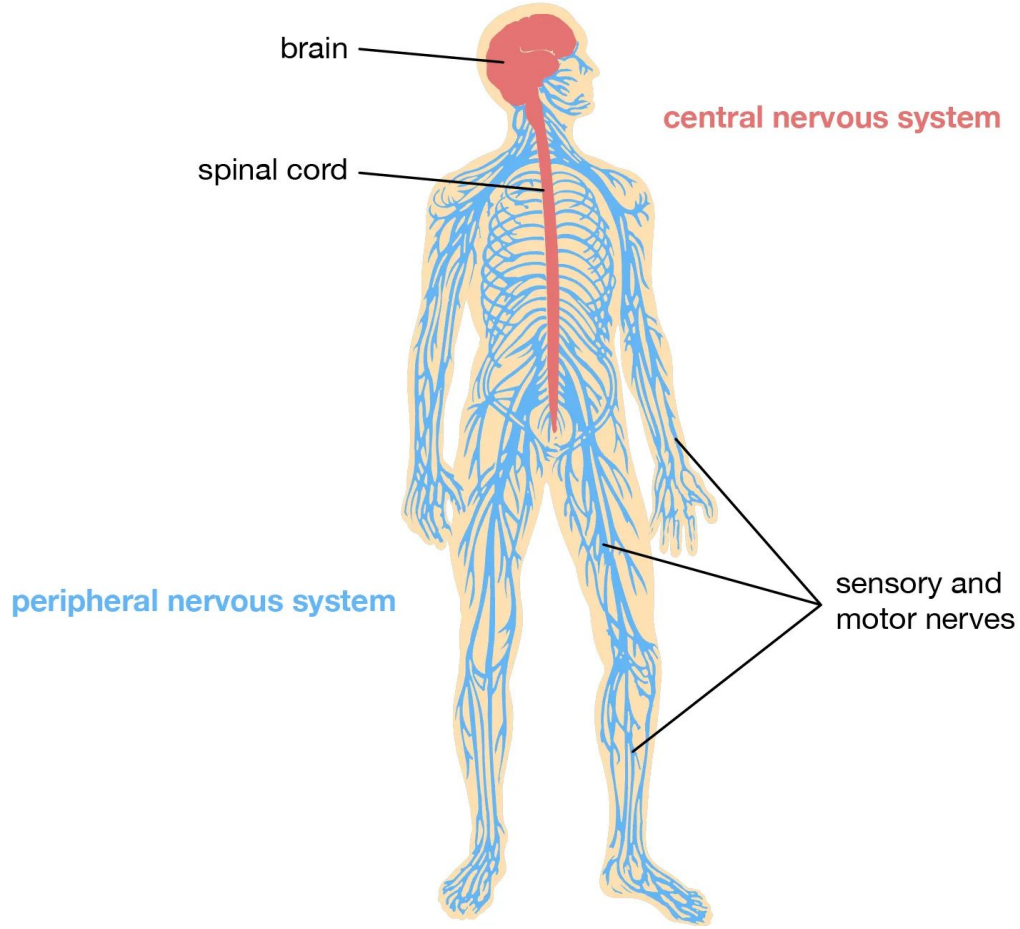
a) Shape

b) Arrangement

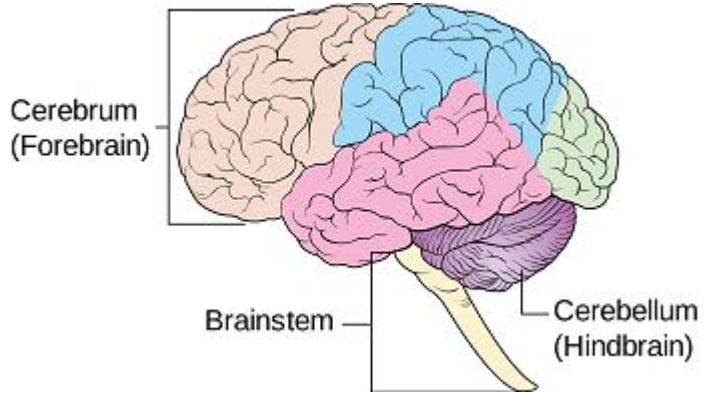
in the cell in response to nervous electrical impulses.

CNS : HUMAN BRAIN & SPINAL CORD

The nervous system



HUMAN BRAIN

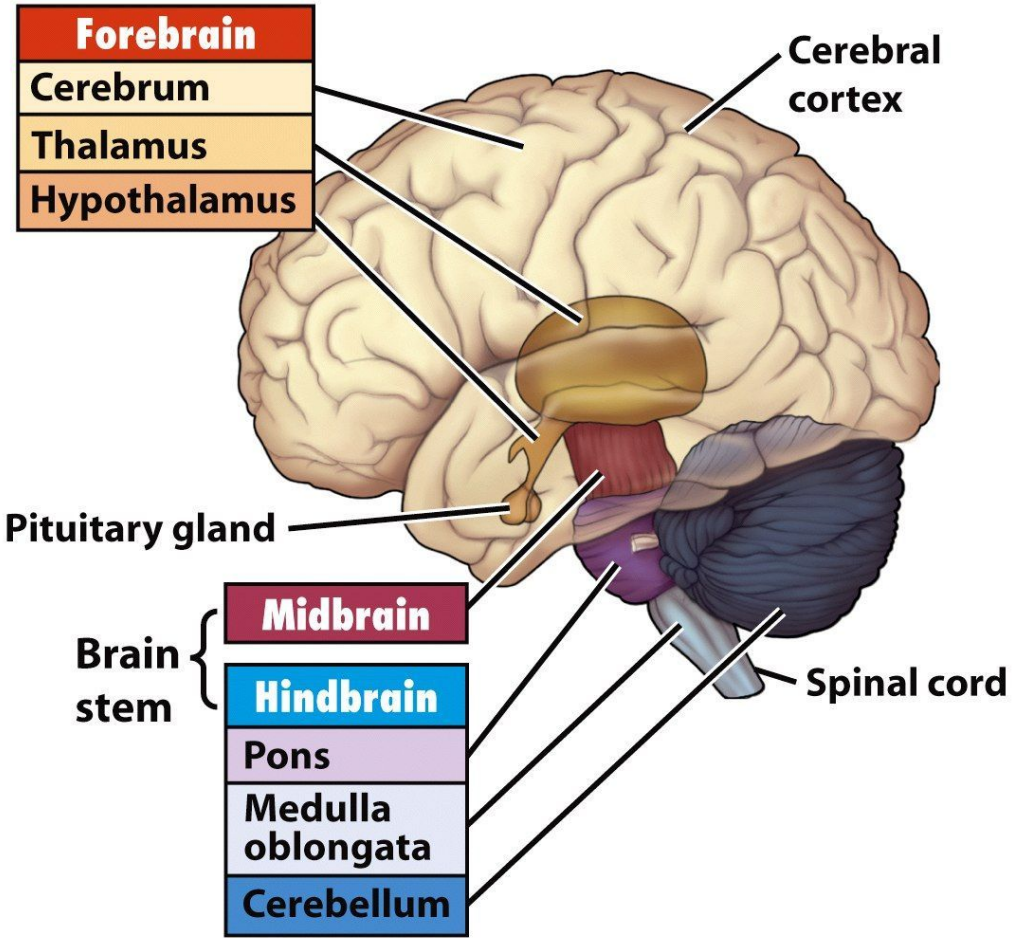


Main coordinating centre in the body. Located inside the skull of our body.

Protected by a bony box in the skull called cranium.

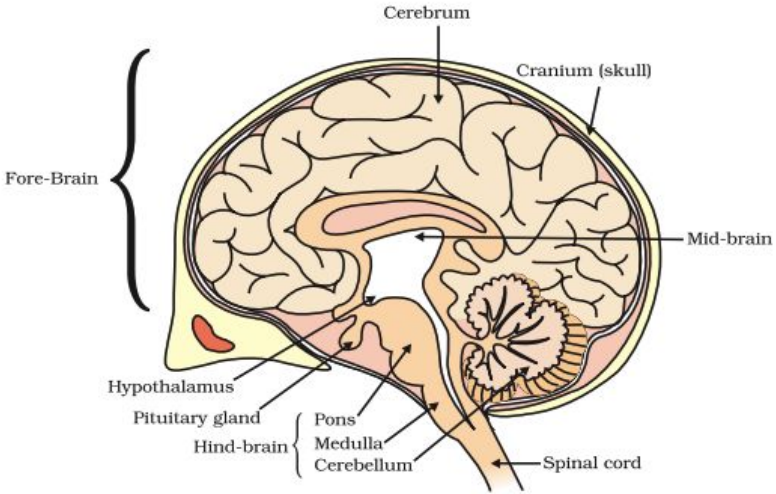
Division of brain

- Forebrain
- Midbrain
- Hindbrain


Forebrain
Cerebrum
Thalamus
Hypothalamus
Cerebral cortex
Pituitary gland
Midbrain
Brain stem
Hindbrain
Pons
Medulla oblongata
Cerebellum
Spinal cord

FOREBRAIN

Most complex & specialised part of the brain.



Functions:

- Main thinking part of the brain. Separate areas are specialised for hearing, smell, sight and so on.
- There are separate areas of association where this sensory information is interpreted by putting it together with information from other receptors as well as with information that is already stored in the brain.
- It has Cerebrum which controls the voluntary action.
- Cerebrum is responsible for reasoning, logic, emotions, speech, memory, visual processing, recognition of auditory and taste stimuli, etc.

MIDBRAIN

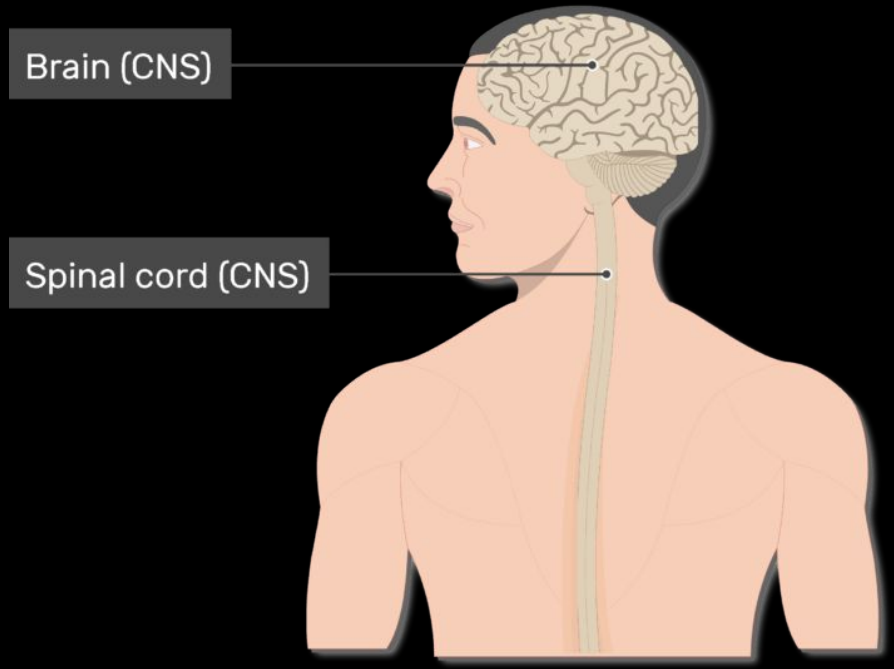
HINDBRAIN

Functions:

- Pons relays signals from hindbrain to forebrain.
- Medulla Oblongata controls all involuntary movements like vomiting, sneezing, yawning, heartbeat, breathing, blood pressure, etc.
- Medulla oblongata continues as the spinal cord which runs through the vertebral column and it controls reflex actions.
- Cerebellum regulates and coordinates body movements, posture and balance.

SPINAL CORD

It is the pathway for messages sent by the brain to the body and from the body to the brain.



Cylindrical structure.

Starts from medula, extends downward.

Enclosed in bony cage called VERTEBRAL COLUMN.

31 PAIRS OF NERVES ARISE FROM IT.

COORDINATION IN PLANTS

Role of Plant Hormones in Coordination

Plants sense environmental changes and respond to them by the action of hormones in them through :

- Promotion of growth
- Stunting of growth

Response to environmental stimuli in plants is known as tropism

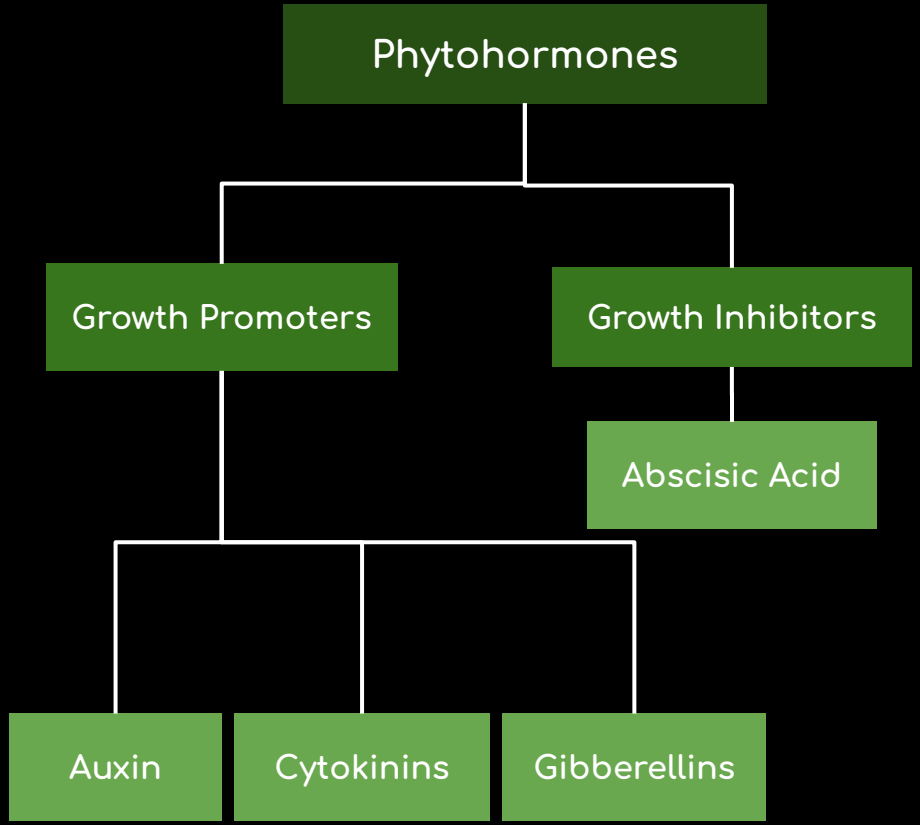
Types of Tropisms

Tropism	Definition
Phototropism	Plant growth response to **light**
Geotropism	Plant growth to **gravity**
Chemotropism	Plant growth response to **chemicals**
Thigmotropism	Plant growth response to **touch**
Hydrotropism	Plant growth response to **water**

- In animals, some cells must change shape in order for movement to happen.
- But plant cells change shape by changing the amount of water in them, resulting in swelling or shrinking, and therefore in changing shapes.

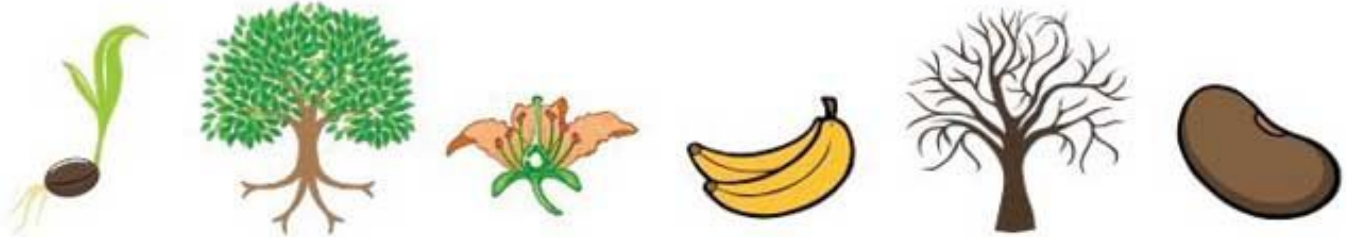
<u>Responses by plants are:</u>

1. Slow
2. Cannot be observed immediately
3. Control by Plant Hormones (also known as *Phytohormones*).


Phytohormones
Growth Promoters
Growth Inhibitors
Abscisic Acid
Auxin
Cytokinins
Gibberellins

Phytohormones

(Plant hormones)



	Germination	Growth to Maturity	Flowering	Fruit Development	Abscission	Seed Dormancy
Gibberellin	✓	✓	✓	✓	✗	✗
Auxin	✗	✓	✓	✓	✗	✗
Cytokinins	✗	✓	✓	✓	✗	✗
Ethylene	✗	✗	✓	✓	✓	✗
Abscisic Acid	✗	✗	✗	✗	✓	✓

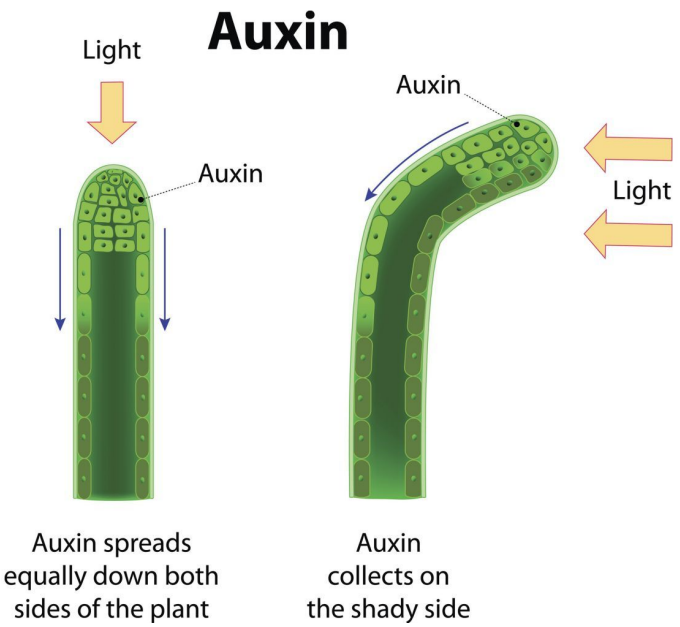
AUXIN

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.

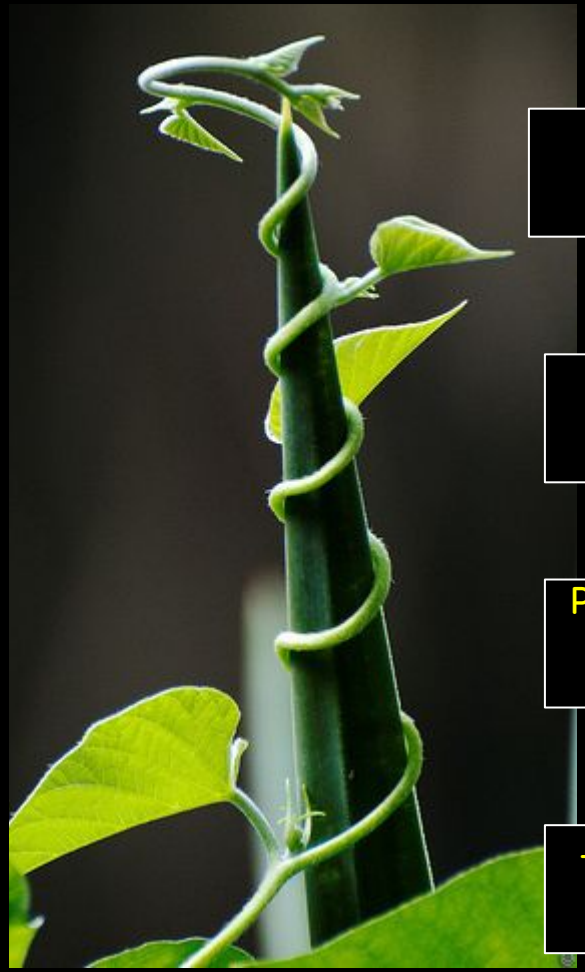


Dormancy in Plants

In plants, dormancy is a period of arrested plant growth. It is a resting, inactive condition in plants in which metabolism stops.

For e.g. seeds are in formant conditions before they get favourable conditions to break the dormancy and grow into a plant.

Similarly, a bud is a young underdeveloped shoot which develops into flower, branch or leaf after breaking dormancy.



THIGMOTROPISM

Response towards Touch

Positive Thigmotropism seen in climbing plants such as Peas.

They curl around the support with the help of Tendrils

S.No	Growth independent (Nastic) movements	Growth dependent (Tropic) movements
i.	These are directionless movements of plants caused due to variations in the outside environment.	These are directional movements of plants caused due to the presence of a specific stimulus.
ii.	In this case, the plant neither moves towards the stimulus nor away from the stimulus.	In this case, the plant either moves towards the stimulus or away from the stimulus.
iii.	Example: The folding or drooping of leaves of 'touch-me-not' plants.	Example: Growth of roots of plants towards the gravity i.e. downwards.

The movement of a plant part in response to an external stimulus in which the stimulus doesn't determine the direction of the movement is known as "Nasties".

This plant is sensitive to touch because of pad-like swellings called as 'Pulvini' at the base of each leaf. These Pulvini have a lot of water pressure which keeps them tight and upright.

But when we touch the leaves, there is a sudden loss of water (and pressure). This causes the leaves to fall!

Mimosa pudica

HUMAN ENDOCRINE SYSTEM

Exocrine Glands: secrete their products into ducts that carry these products to other organs or outside the body.
Example: Salivary gland.

Endocrine Glands: secrete their products directly into the bloodstream.

A structure (group of cells or tissue) that makes hormones in the body is called endocrine gland.

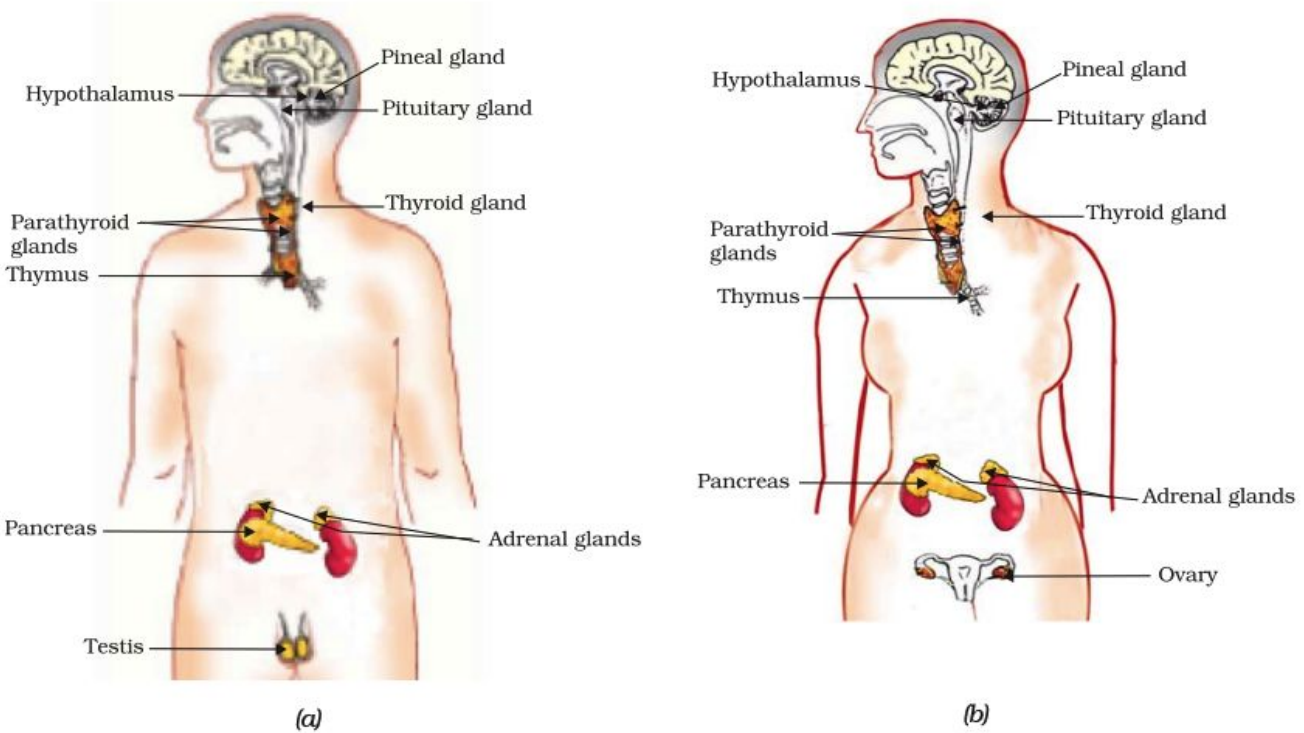


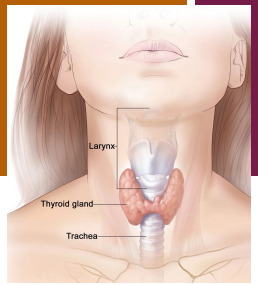
Figure 7.7 *Endocrine glands in human beings (a) male, (b) female*

THYROID

Largest endocrine gland located in the larynx in the neck. It is bilobed gland. It secretes 3 hormones :

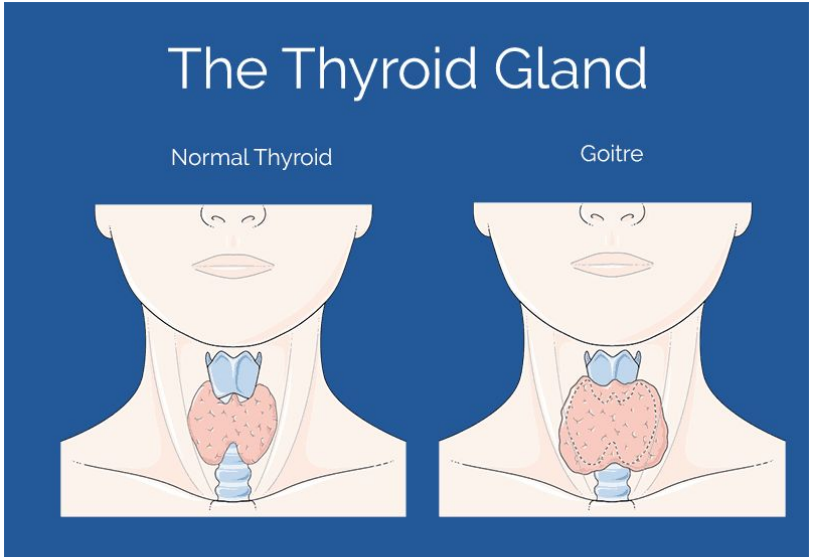
- a) Thyroxine (T4)
- Triiodothyronine (T3)
- Thyrocalcitonin

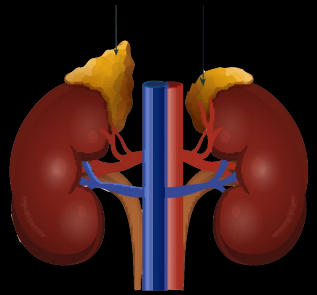
T3 and T4 regulate metabolic rate, stimulate protein synthesis, and performs development of mental faculties. It also helps in body temperature.



PARATHYROID

- There are 4 small parathyroid glands in thyroid.
- They secrete a hormone known as Parathormone.
- Function of Parathormone : Is to regulate calcium and phosphate levels in blood.


The Thyroid Gland
Normal Thyroid
Goitre



ADRENAL GLANDS- GLAND Of EMERGENCY

Pituitary Gland

Pancreas

Hormone	Endocrine Gland	Functions
Growth hormone	Pituitary gland	Stimulates growth in all organs
Thyroid	Thyroid gland	Regulates metabolism for body growth
Insulin	Pancreas	Regulates blood sugar level.
Testosterone	Testes	Control the development of male sex organs and male features.
Oestrogen & Progesterone	Ovaries	Development of female sex organs,regulates menstrual cycle, etc.
Adrenaline	Adrenal Gland	Prepares body for emergency
Releasing hormone	Hypothalamus	Stimulates pituitary gland to release hormones

Nervous System	Endocrine System
System made up of nerve cells.	System made up of set of glands.
Messages transmitted in the form of electrical impulses.	Messages transmitted in the form of chemicals called hormones.
Messages transmitted along nerve fibres.	Messages transmitted through blood stream.
Messages travel very quickly.	Message travel more slowly.
Effect of message usually lasts for a very short while.	Effect of message usually lasts longer.

What you have learnt

- Control and coordination are the functions of the nervous system and hormones in our bodies.
- The responses of the nervous system can be classified as reflex action, voluntary action or involuntary action.
- The nervous system uses electrical impulses to transmit messages.
- The nervous system gets information from our sense organs and acts through our muscles.
- Chemical coordination is seen in both plants and animals.
- Hormones produced in one part of an organism move to another part to achieve the desired effect.
- A feedback mechanism regulates the action of the hormones.

NCERT QUESTIONS

EXERCISES

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.

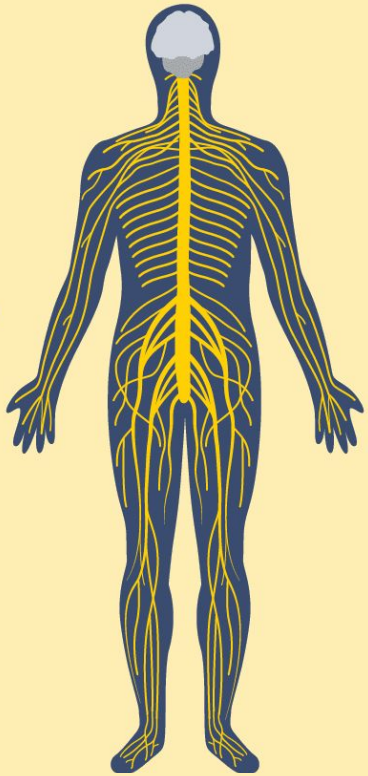
3. The brain is responsible for
   (a) thinking.
   (b) regulating the heart beat.
   (c) balancing the body.
   (d) all of the above.
4. What is the function of receptors in our body? Think of situations where receptors do not work properly. What problems are likely to arise?
5. Draw the structure of 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?


thank
you

What Does the Peripheral Nervous System Do?

Connects the central nervous system to the organs, limbs, and skin

Allows the brain and spinal cord to receive and send information to other areas of the body



Carries sensory and motor information to and from the central nervous system

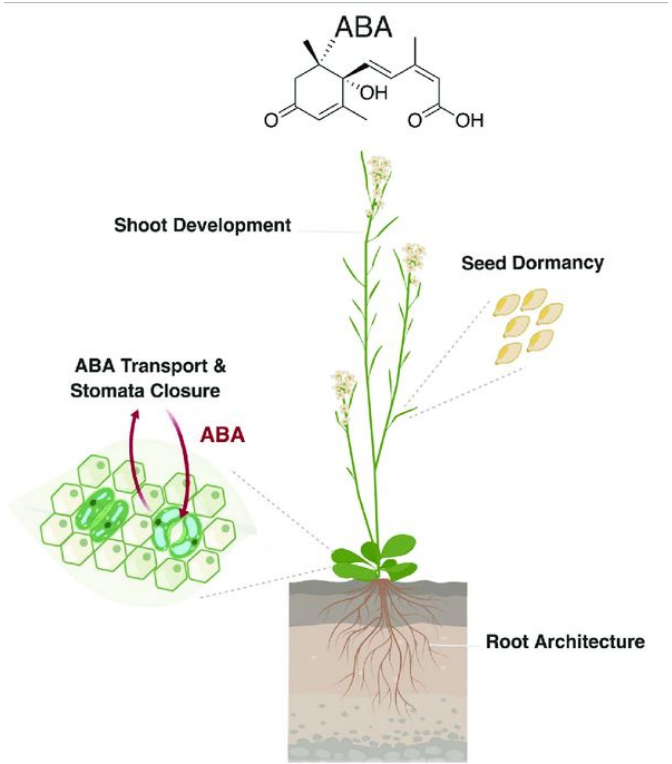
Regulates involuntary body functions like heartbeat and breathing

GIBBERELLINS

- They promote fruit growth.
- Induces Maleness in certain plants. E.g. cannabis
- Breaks seed dormancy.
- Elongation of Shoots.

CYTOKININS

- They promote root growth
- Formation of chloroplast.
- Delay ageing in leaves.
- Promote opening of Stomata



ABSCISIC ACID

- Promotes Dormancy in Seeds.
- They promote closing of stomata
- Promotes wilting and falling of leaves.

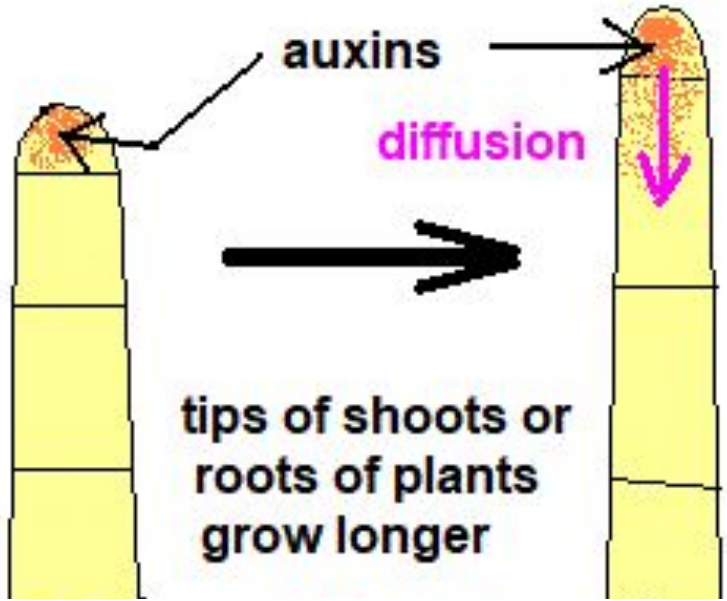
Plant Movements

Plants don't move from one place to another like animals (locomotion).

They show movement of specific parts of plant body in the form of GROWTH.

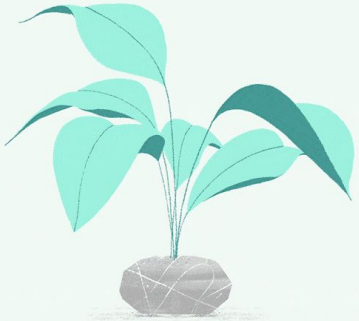
These movements are usually caused by an unequal growth in its two regions by the action of plant hormones, under the influence of the stimulus.

Auxins promote the growth in stem. They are present in the meristematic tissue at the tip of the stem.



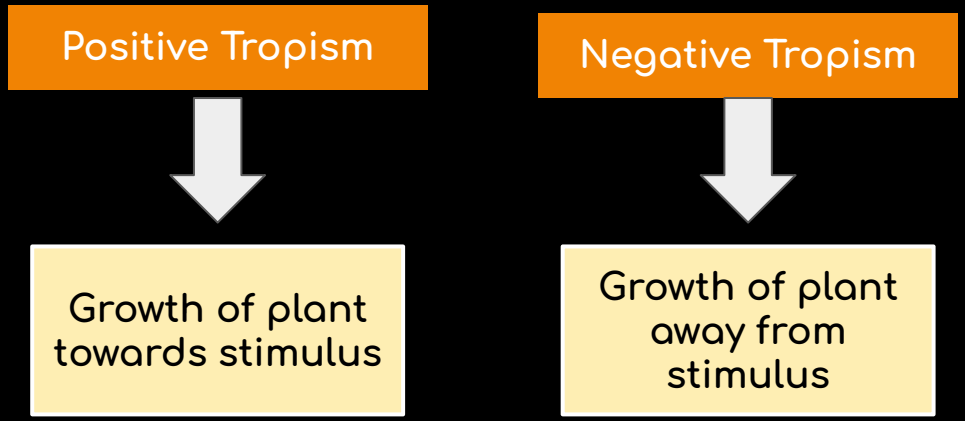
Types of Plant Movements:

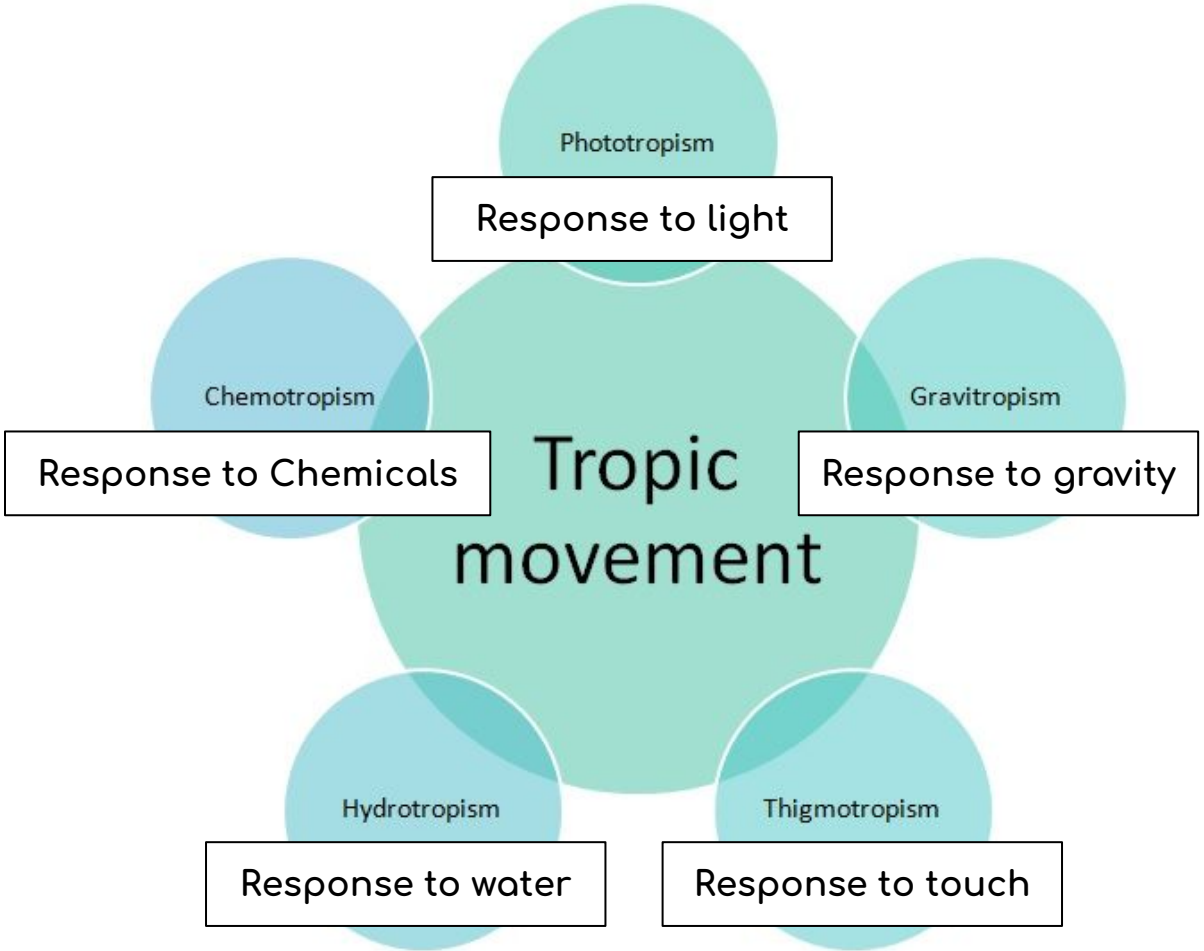
1. Tropisms
2. Nasties



TROPISM:

1. Also known as Tropic Movement.
2. It is a type of growth movement of a plant part in response to an (external) stimulus in which the direction of the stimulus determines the direction of response.




Phototropism
Response to light
Chemotropism
Response to Chemicals
Tropic movement
Gravitropism
Response to gravity
Hydrotropism
Response to water
Thigmotropism
Response to touch

Phototropism:

The movement of the plant part in the response to light is called as Phototropism.

Positive Phototropism : Seen in stems. They grow towards the light source.

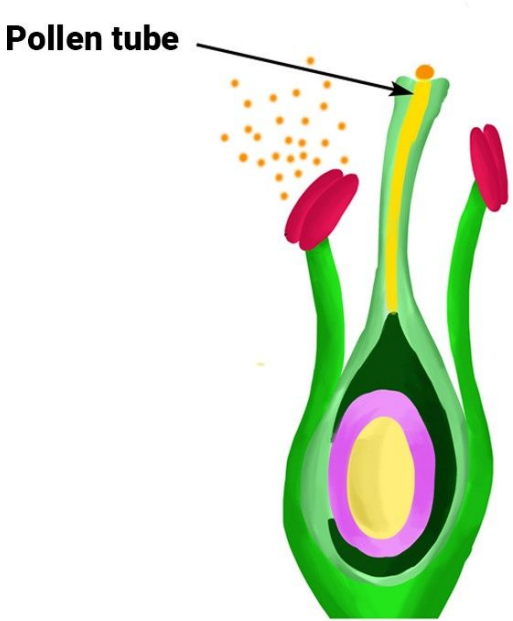
Negative Phototropism: Seen in Roots. They grow away from the light source.

If there is a dark box in which light enters only at an angle, then the plant moves towards the light source proving positive phototropism.

- Response of plant towards gravity.
- Also known as Gravitropism.

Positive Geotropism: Shown by Roots as they grow towards gravity

Negative Geotropism: Shown by Shoots as they grow away from gravity.



Chemotropism:

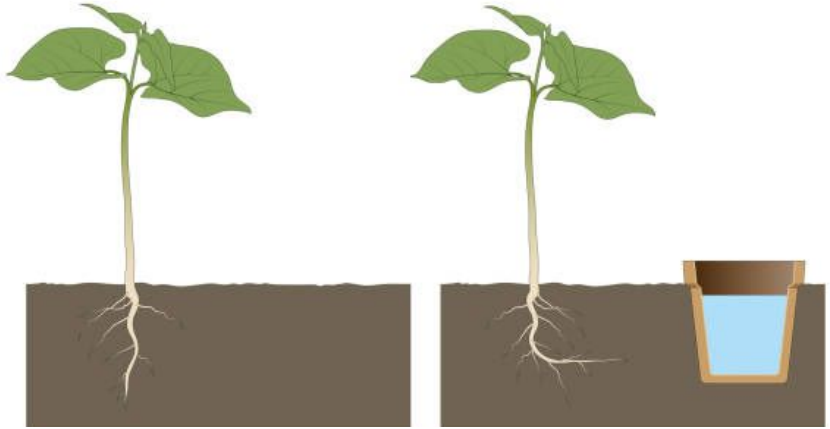
It is movement of plant in response to chemical stimuli.

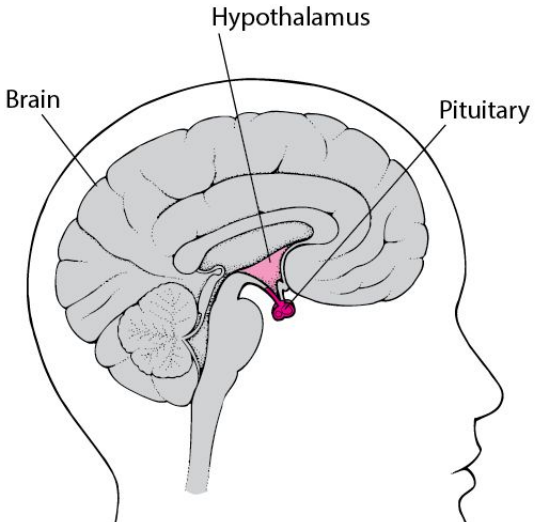
Example: Growth of pollen tube towards the ovule.

Hydrotropism:

Movement of part of a plant towards/away from water.

Roots are positively hydrotropic. They grow towards the source of water.





Hypothalamus

- Present in brain.
- Produces 'releasing hormones' & 'inhibitory hormones'.
- Function- Regulate the secretions of hormones from pituitary gland.

Collects information from different parts of brain and passes it on to pituitary gland by its own secretion.

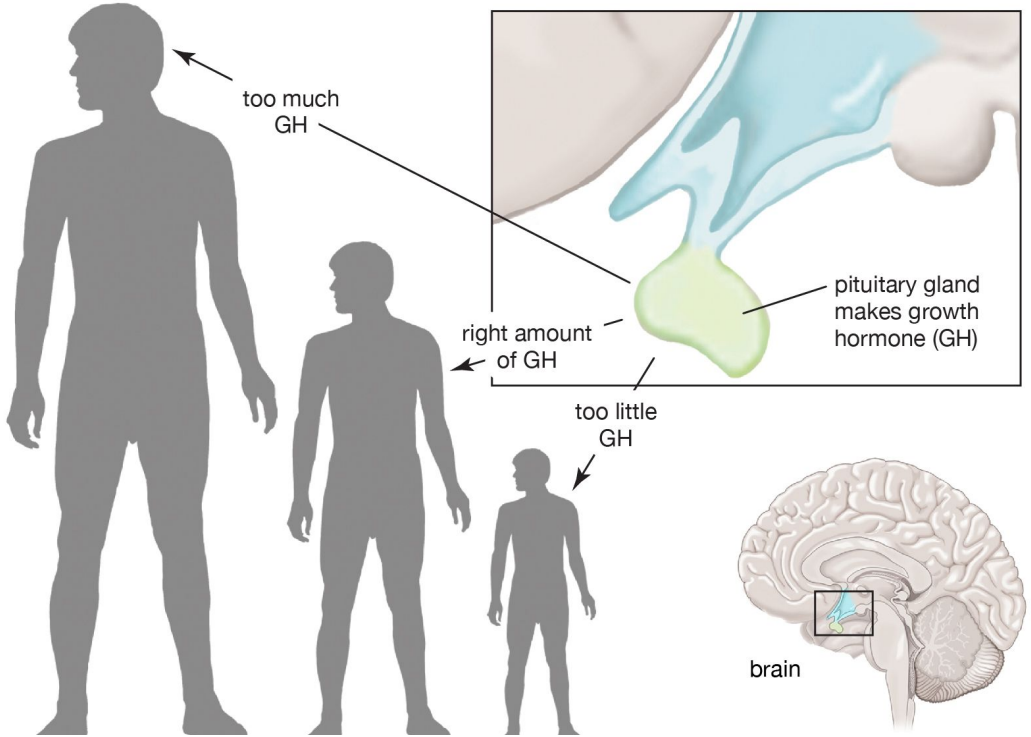
Pituitary Gland

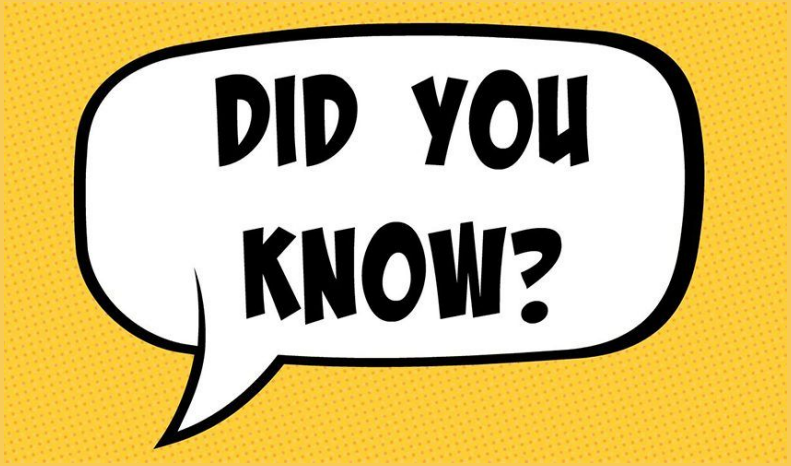
Located just below the brain.

It is the master gland as it controls the secretions of all the other endocrine glands.

It regulates growth & development. The growth hormones control the growth of the human body.

A person having deficiency of growth hormones in childhood remains very short and becomes a dwarf.


too much
GH
pituitary gland
makes growth
hormone (GH)
right amount
of GH
too little
GH
brain



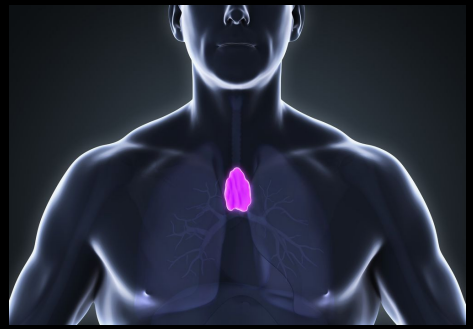
Hypothalamus plays an important role in the release of many hormones. For example, when the level of growth hormone is low, the hypothalamus releases growth hormone releasing factor which stimulates the pituitary gland to release growth hormone.

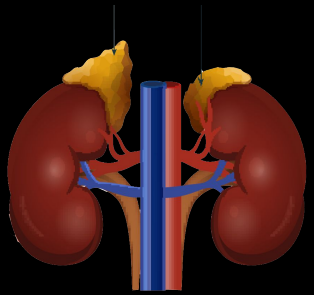
PANCREAS

- Located below stomach. Secretes hormone called- insulin.
- Function- Lower the blood sugar level (or blood glucose level).
- Deficiency of insulin hormone causes- Diabetes.

THYMUS GLANDS

- Lies in the lower part of the neck & upper part of chest.
- Thymus gland secretes thymus hormone which plays a role in the development of the immune system of the body.
- Gland shrinks after puberty.



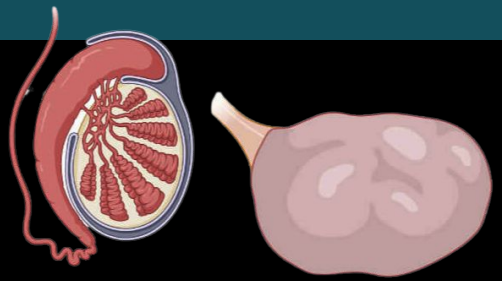


ADRENAL GLANDS- GLAND OF EMERGENCY

- Pair of adrenal gland present one on top of each kidney.
- Secrets the hormone adrenaline.
- Function of adrenaline hormone- Regulate heart rate, breathing rate, blood pressure & carbohydrate metabolism.
- Triggers the body's fight-or-flight response.

GONADS

- Gonads are the gamete-producing organs – testes in males and ovaries in females.
- Testes make male sex hormones called- testosterone.
- Ovaries make two female sex hormones called- Oestrogen & Progesterone.



Secretion of Hormones

If it is so important that hormones should be secreted in precise quantities, we need a mechanism through which this is done.

The timing and amount of hormone released are regulated by feedback mechanisms.

For example, if the sugar levels in blood rise, they are detected by the cells of the pancreas which respond by producing more insulin. As the blood sugar level falls, insulin secretion is reduced.