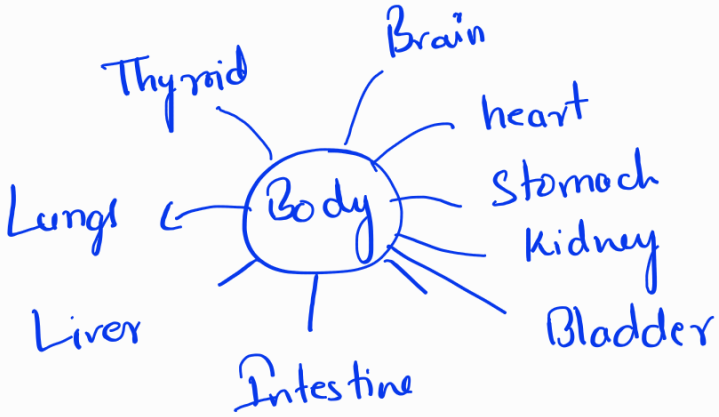
Chapter 6:
Control and Coordination

What is control and Coordination?

The process of working together of various parts of body in a regulated manner.

Eg.



Types of Coordination

Nervous Coordination

→ Nervous system (Brain, etc.)
↓
made up of nerve cells (neurons)
↓
electrical signals/impulse
↓
electrical messenger
⇒ Electrical Coordination
⇒ Only in Animals

Hormonal Coordination

↓
Hormones are used for messaging
→ Chemical messenger.

⇒ Chemical coordination
⇒ Both Animals & Plants.

⇒ Advantage: Fast

⇒ Electrical signals / nerves don't reach to each cell.

⇒ for quick actions / decisions

⇒ Slow.

Ad. ⇒ message reaches to each & every cell of body.

⇒ for important actions.

In this chapter we are going to study 3 things:

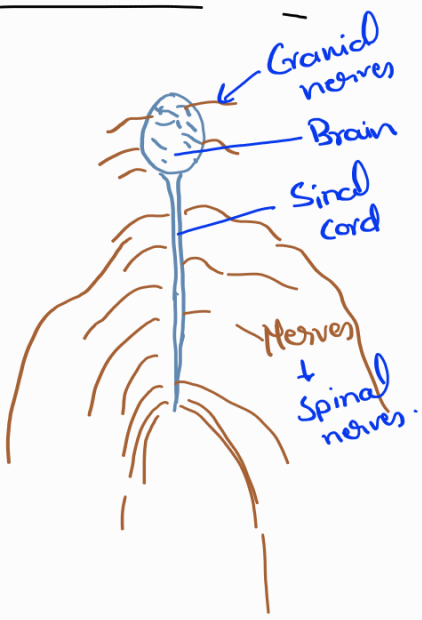
→ Nervous coordination in Humans.

→ Hormonal coordination in Humans.

→ Hormonal Coordination in Plants.

NERVOUS COORDINATION in HUMANS

↳ done by nervous system.



Nervous System

- Central NS (CNS)
  - ↓
  - Brain & Spinal Cord
- Peripheral NS (PNS)
  - ↓
  - Nerves
    - Somatic Nerves
      - → Controls Voluntary muscles & transmits sensory info. to CNS
    - Autonomic Nerve
      - → Controls involuntary body functions.

Autonomic Nerve

Sympathetic Nerves

Arouses body to expend energy

⇒ (Fight or Flight responce)

⇒ Activated in emergency situations

⇒ Dilates pupil

⇒ Inhibit Salivation

⇒ Relaxes airways

⇒ Increases heart beat

⇒ Inhibits stomach activity

Parasympathetic Nerves

Calms body to conserve & maintain energy

⇒ (Rest and digest)

⇒ Constric Pupil.

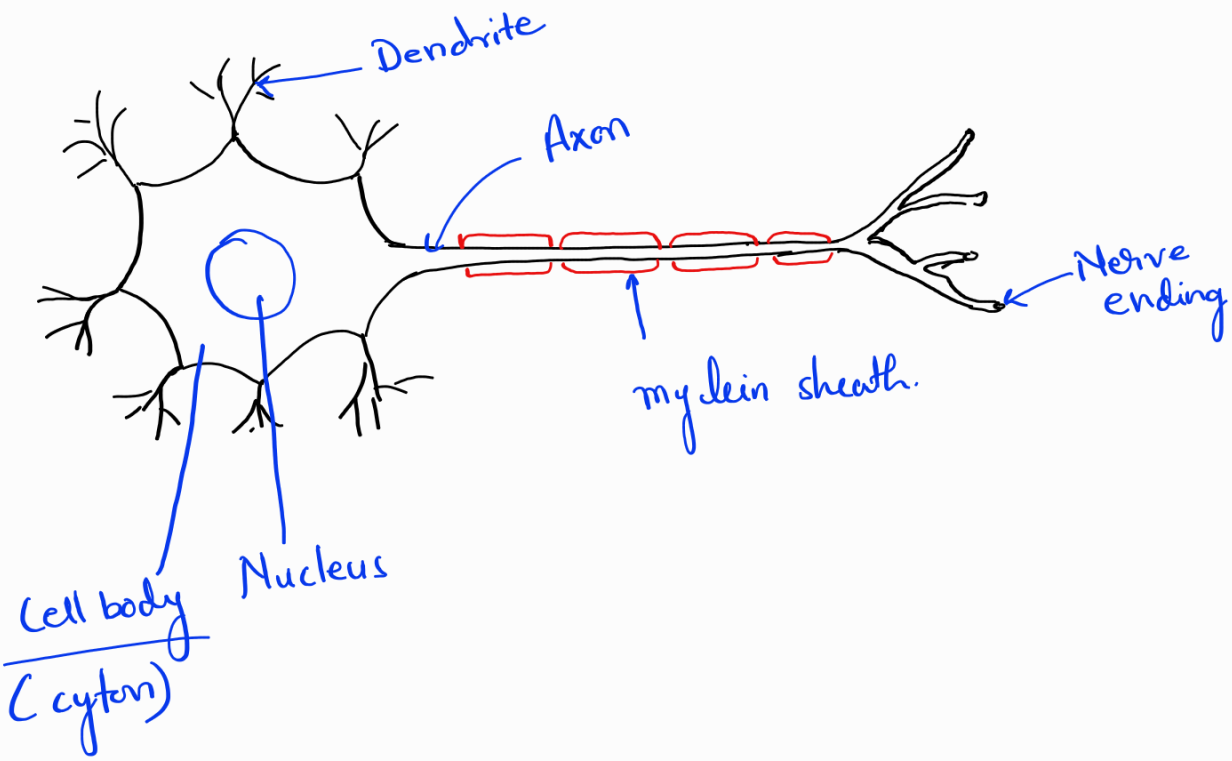
⇒ Stimulate Salivation

⇒ Constric airways

⇒ Slow downs heart beat

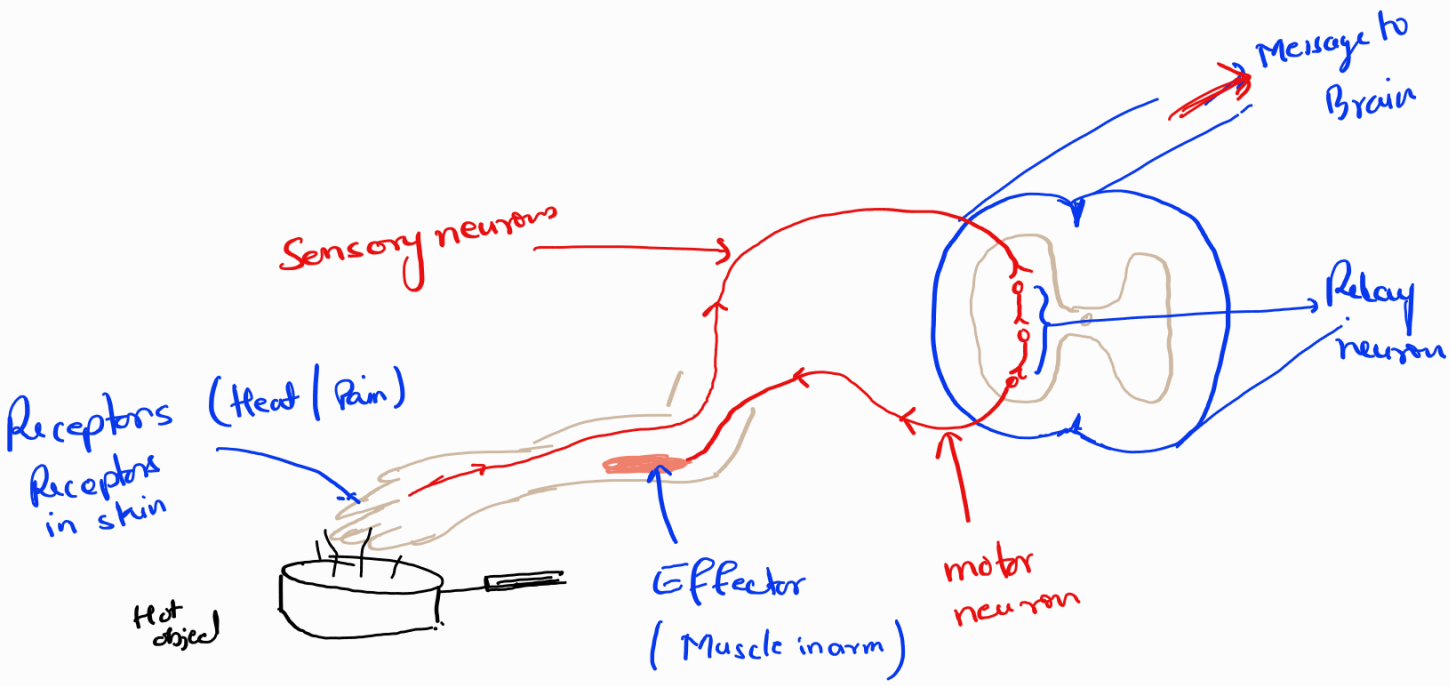
⇒ Stimulate Stomach activity.

Neuron : The Nerve Cell



Types of neurons

- Sensory neurons
- Relay neurons
- Motor Neurons



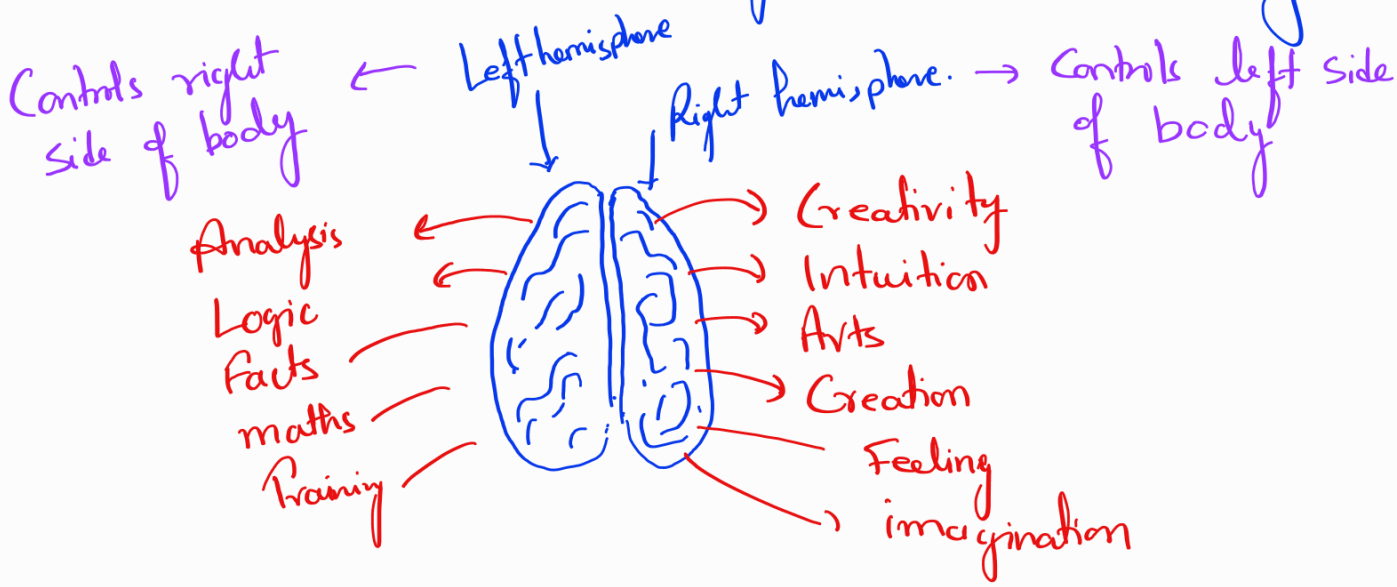
Types of sensory neurons : (5 - types)

We have different sensory neurons for 5 sense organs.

- Hearing (Ear) → Neurons to sense sound ← Audio-Receptors (Ear - Sound)
- Smell (Nose) → Neurons to sense odour / smell. ← Olfacto-Receptor (Nose - Smell)
- Touch (skin) → Neurons to sense / feel touch / pressure ← Thigmo-receptor (skin - touch)
- Vision (eye) → Neurons to sense / recieve light. ← Photo-Receptors (Eye - light)
- Taste (Tongue) → Neurons to sense / recieve taste of chemicals. ← Gustato-Receptor (Tongue - taste)

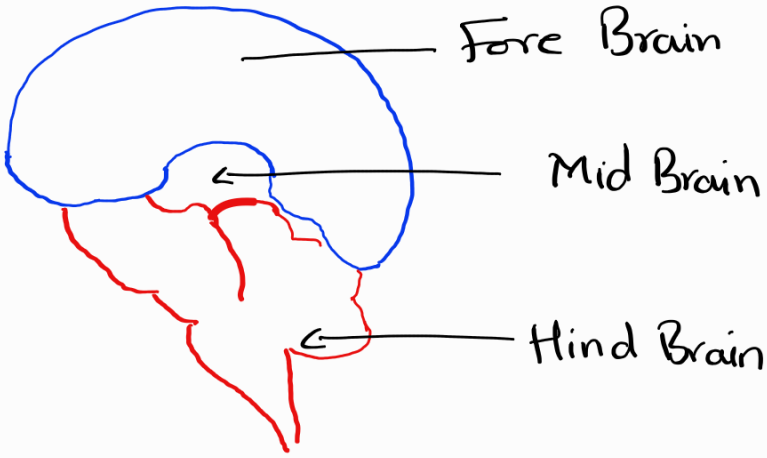
Human Brain

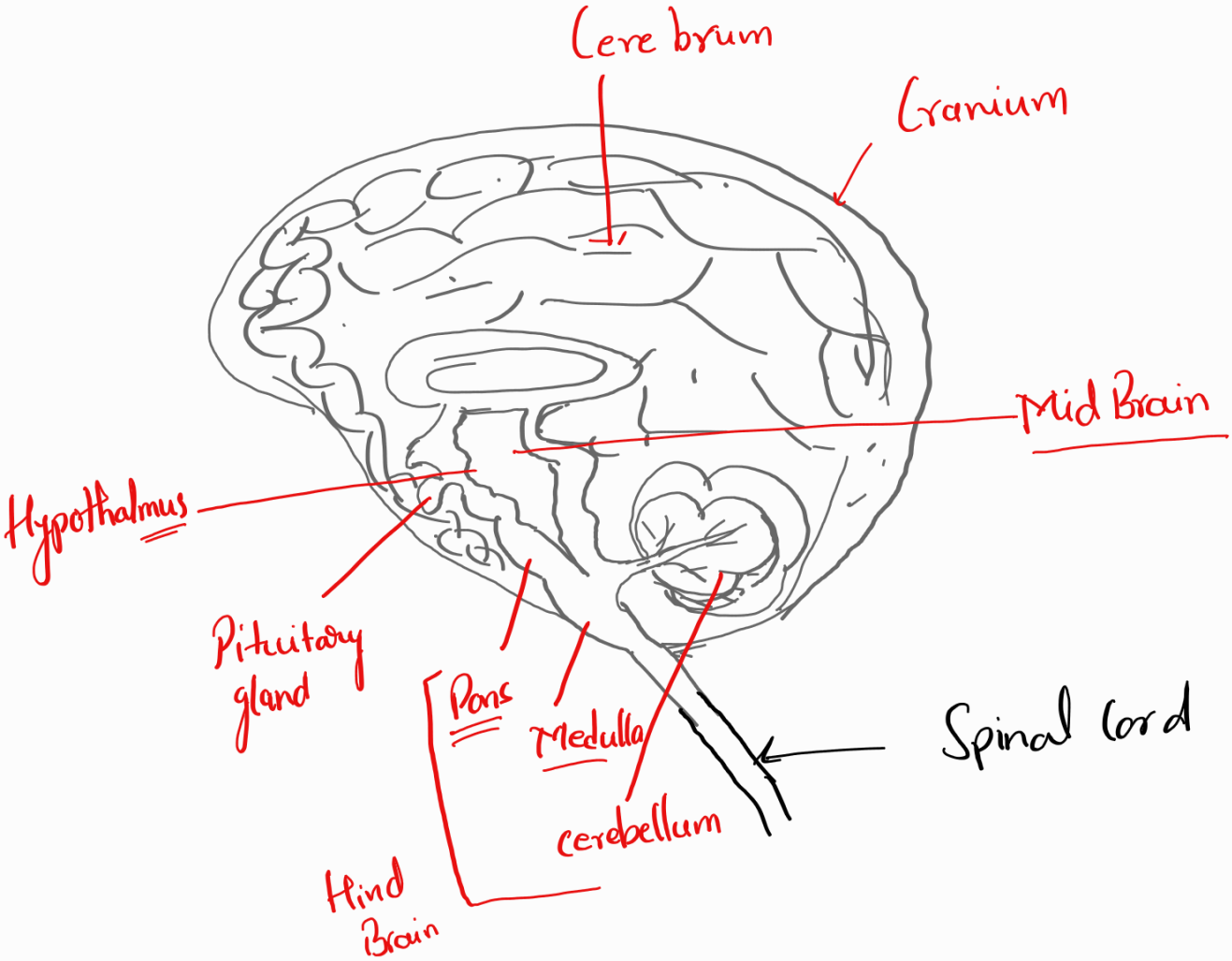
↳ Main thinking part of our body.



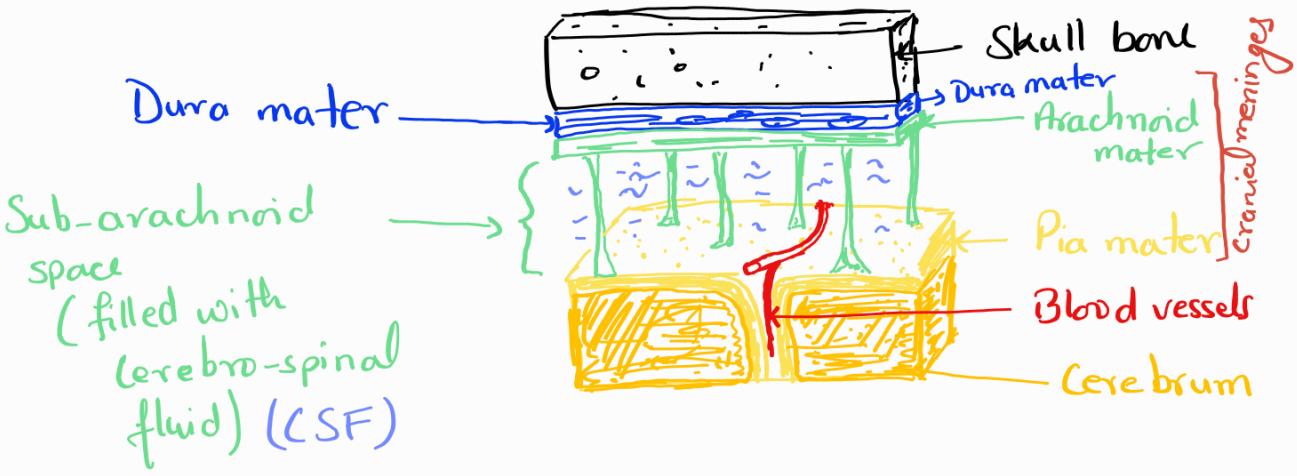
⇒ 3 main parts of Brain

- ↳ Fore Brain
- ↳ Mid Brain
- ↳ Hind Brain





Protection of Brain



→ Brain is protected by hard covering i.e. skull bone. and three layered Cranial meninges.

↳ CSF is filled inside meninges acts as shock absorber

Meningitis :→ a kind of brain fever due to inflammation of meninges (membrane) mainly by viral infection.

Encephalitis :→ inflammation of the brain
→ Kind of Brain fever.

Functions

① Fore Brain : aka Cerebrum

⇒ Main thinking part of the brain.
⇒ Most complex part of the brain
⇒ Consists of the cerebrum.
⇒ Controls voluntary actions of our body.

Functions of forebrain :

- Thinking part of the brain.
- Controls the voluntary actions.
- Store information (memory)
- Receives sensory impulse from various parts of the body and integrates its.
- Centre associated with hunger.

Functions of Mid-Brain and Hind-Brain

* Mid and hind brain is generally responsible for involuntary actions.

* NCERT does not talk about mid-brain much

Hind Brain

→ It has 3-parts

(i) **Cerebellum** :

- Controls posture and balance of the body.
- Controls precision of voluntary actions.

  eg. • walking precisely in a straight line.
  • Picking pen.

(ii) **Medulla** :

- Controls involuntary actions, like –
  - Blood pressure, Saliration, vomiting, heart beat, peristalsis, etc.

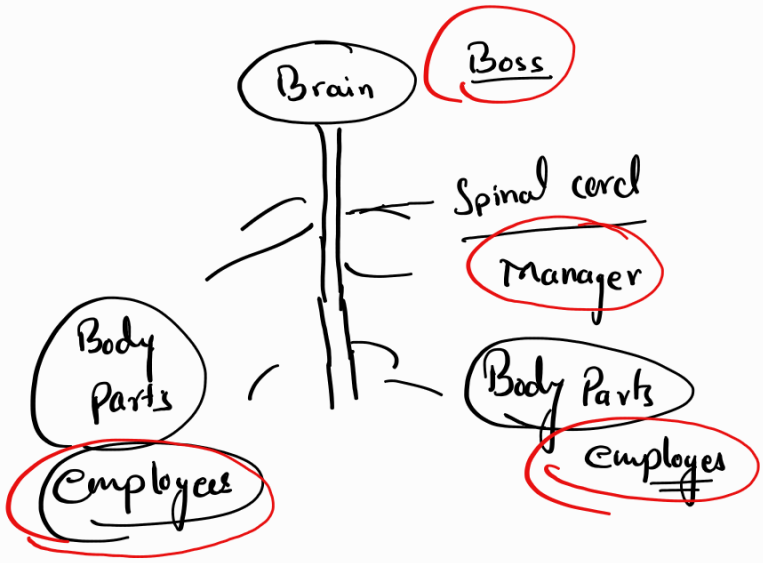
(iii) **Pons** :

- Controls involuntary actions, like –
  - regulation of respiration / breathing.
  - eye movement during sleep
  - Sleep-wake cycle.

(2) Spinal Cord

12 pair → Cranial nerve

31 pair → Spinal nerve



Functions :

① SC connects large part of the peripheral nervous system to the brain.

⇒ 31 pairs of spinal nerves arises from the spinal cord.

② Reflex Action (Instant reactions)

→ It is a quick, sudden and immediate response of the body to a stimulus.

Ex. knee jerk, withdrawl of hand on touching a hot object.

Reflex Arc : The pathway through which nerve impulses pass during reflex action.

[Explain through diagram]

Synapse : It is the gap between the nerve ending of one neuron and dendrite of the other neuron. Here the electrical signal is converted into chemical signal for onward transmission.

How does the Nervous Tissues cause action?

Nervous tissue
- → Collects info.
- → Processes info.
- → takes decisions based on info.
- → Conveys decisions to muscles for final action.

* Final action is always taken by muscle tissue.

for eg. movement., sneezing, vomitting, etc.

⇒ Muscle can change shape to perform any action → HOW?

Muscle tissue —has→ Special Proteins
- → Actin
- → Myosin
- → Tropomyosin
- → Troponin.

Can change shape and arrangement in response to electrical impulses from nerves.

Types of Responses

Voluntary action

eg. Writing, walking, eating

Involuntary actions

eg.
- heart beat
- digestion
- Circulation
- Blood pressure
- Blinking
- Sneezing.

Reflex action

- Quick response
  - Blinking
  - Coughing
  - Sneezing

Hormonal Coordination

(1) Plant Hormones

(2) Human Hormones.

Plant Hormones

⇒ aka Phytohormones / Growth regulators

Growth Promoter

1. Auxins: Cell elongation
2. Gibberellins: → Stem elongation
   ↳ leaf expansion
3. Cytokinins

Growth Inhibitor

1. Abscisic acid
2. Ethylene

* Gibberellins stimulates stem elongation and leaf expansion.

* Cytokinins :→ • It promotes rapid cell division.
  ↳ found in fruits, seeds.
  • Promotes opening of stomata.

Cytokinins: Cyto (Cell) + kinins (Division (Kinesis))

* **Auxin** : Synthesized at shoot tip when plant detects light.

→ Light sensitive.

– Responcible for bending of stem towards light.

* **Abscisic Acid** : → Suppresses the growth of plant

→ wilting of leaves

→ Maintaining seed dormancy

→ Shedding of leaves / fruits. → Abscission

* **Ethylene** : → Ripening of fruits

→ Sex determination of flower

→ Opening of flower

→ Shedding of leaves.

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

Coordination in Plants

Nastic movements

* Growth Independent movements.
* Direction of response is not determined by the direction of external stimulus.
* Nastic movements are generally shown by flat parts of the plants
  ↳ leaves, petals, etc.

* Nastic movements are fast

eg ① Daisy flowers
↳ Closes at dusk and opens at daybreak.
⇒ Stimulus is light
⇒ Opening and closing of flower is independent of direction of light.

eg ② Touch-me-not plant (Mimosa family) (chhui-mui)
↳ Leaves are touch sensitive.
↳ when leaves are touched, they fold-up and drop.
⇒ Folding of leaves always occurs in same direction irrespective of direction of touch stimulus.

* Plants do not have nerves, like animals, then how they respond to stimuli.

↳ They use electrical-chemical means to convey the information of stimulus from cell to cell.

→ Plants performs nastic movements by changing the shape of the cells.

↳ by changing the amount of water in cell.

↓

Results in swelling or shrinking of cell and thus shape of cell changes.

Movement due to Growth

* Growth dependent movements.

* Direction of response is determined by the direction of external stimulus.

⇒ Tropic Movement or Tropism.

↓

The movement of plant organs towards or away from a stimulus is k/a tropism.

* Tropic movements are slow.

↓

The stimulus needs to be continued for a longer time for the effects to be noticed.

Types of Tropic movements in plants

1. → Phototropism
2. → Geotropism
3. → Thigmotropism
4. → Hydrotropism
5. → Chemotropism

① Phototropism

* Movement of plant parts towards or away from light is termed as phototropism.

⇒ **Positive Phototropism**: Movement of plant part towards source of light.

eg: Shoots of most plants grow towards the light source

↳ Shoots show positive phototropism.

⇒ **Negative Phototropism**: Movement of plant part away from the light source.

eg: Roots are negatively phototropic, as they grow away from the light source.

② Geotropism:

* Movement of plant parts in response to gravity is termed as geotropism.

⇒ Roots are positively geotropic as they grow in the direction of the gravity (towards the centre of the earth).

⇒ Shoots are negatively geotropic, as they grow upwards i.e. against gravity

③ Thigmotropism

* Movement of plant parts in response to touch stimulus is termed as thigmotropism.

  touch stimulus → caused by physical contact with solid object.

⇒ Plants with weak stems, uses twining stems and tendrils to climb on other plants / objects.

⇒ Twining stems and tendrils are positively thigmotropic.

⇒ The growth of roots underneath the soil is negatively thigmotropic.

  negatively thigmotropic → when growing tip of root comes in contact with rock it grows away from it.

④ Hydrotropism

* Movement of plant parts in response to water is termed as hydrotropism.

⇒ Roots are positively hydrotropic, as they grow towards the source of moisture.

⇒ Growth of stem is away from moisture content.

∴ stems are negatively hydrotropic.

⑤ Chemotropism :

* The movement of plant parts is response to a chemical stimulus is called chemotropism.

- **Positive Chemotropism** : Movement towards chemical stimulus.

⇒ Growth of pollen tube towards ovules, in response to sugars present in the style.

- **Negative chemotropism** : Movement away from the chemical stimulus.

⇒ Roots grow away from the harmful chemicals ⇒ negativily chemotropic.

⇒ Roots also grow towards useful minerals ⇒ positively chemotropic.

Animal Hormones

* Chemicals (proteins/fat) secreted by endocrine glands.
  ⇒ Endocrine glands are ductless glands, which pour their secretions directly into blood stream.

1. Adrenaline

* Secreted by adrenal gland.
  ↓
  found above kidneys.

Functions:

- Adrenaline prepares body for fight and flight mechanism.

Adrenal Gland → Adrenaline into blood
↓
Carried to different body parts

- Heart beats faster → Supplies more O_2 to blood
- Blood supply to skin & digestive system is reduced (due to muscle contraction around arteries) → More blood flow to skeletal muscle
- Diaphragm & Rib-muscle contracts. → Breathing rate increases.

2. Thyroxin

* Secreted by thyroid gland.
  ↓
  Neck region over trachea

Functions:

→ Regulates carbohydrates, protein and fat metabolism.

→ It increases the basal metabolic rate (BMR)

→ It regulates body growth such as ossification of bones and mental development.

* Iodine is required for the production of thyroxin in thyroid gland.

Disorders: Goitre

3. Growth hormone

* Secreted by the anterior lobe of pituitary gland.

Function:

→ Essential for normal growth of body.

Disorders: Dwarfism & Gigantism.

④ **Insulin**

* Secreted by endocrine part of pancreas

Function: Regulates blood glucose (sugar) level.

Disorder: Diabetes Mellitus (Hyperglycemia)

⑤ **Testosterone**

* Secreted by testes in males

Function:
- Controls development of sex organs in males.
- Controls the development of secondary sexual characters during puberty in males.

⑥ **Oestrogen:**

* Secreted by ovaries in females

Function:
→ Controls the development of female sex organs.
→ Regulates menstrual cycle.
→ Controls the development of secondary sexual characters during puberty in females.

⑦ Releasing Hormones:
Inhibiting Hormones:

* secreted by hypothalamus

Function: • Stimulates pituitary gland to release hormones / inhibit release of hormons.

* Feedback mechanism

→ This mechanism helps to regulate the precise secretion of hormones.

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

Positive Feedback mechanism	Negative Feedback mechanism
↳ increases the secretion of hormones when its level drops below the normal range	↳ decreases the secretion of hormones when its level rises above critical range.

Ex: Blood sugar level

Increase in blood glucose level:

↳ Secretion of insulin increase

Fall in blood glucose level:

↳ Secretion of insulin decreases.