

CONTROL & CO-ORDINATION

One of the 7 characteristics of living organisms is irritability. And this is the ability to detect a change in the outer environment & to respond to it.

- STIMULUS → A change in environment.
- RESPONSE → Actions taken by the body in order to co-operate with a stimulus are called responses.
- RECEPTORS → The body detects a stimulus by parts in the body called receptors.
- EFFECTORS → The parts through which body is able to respond.

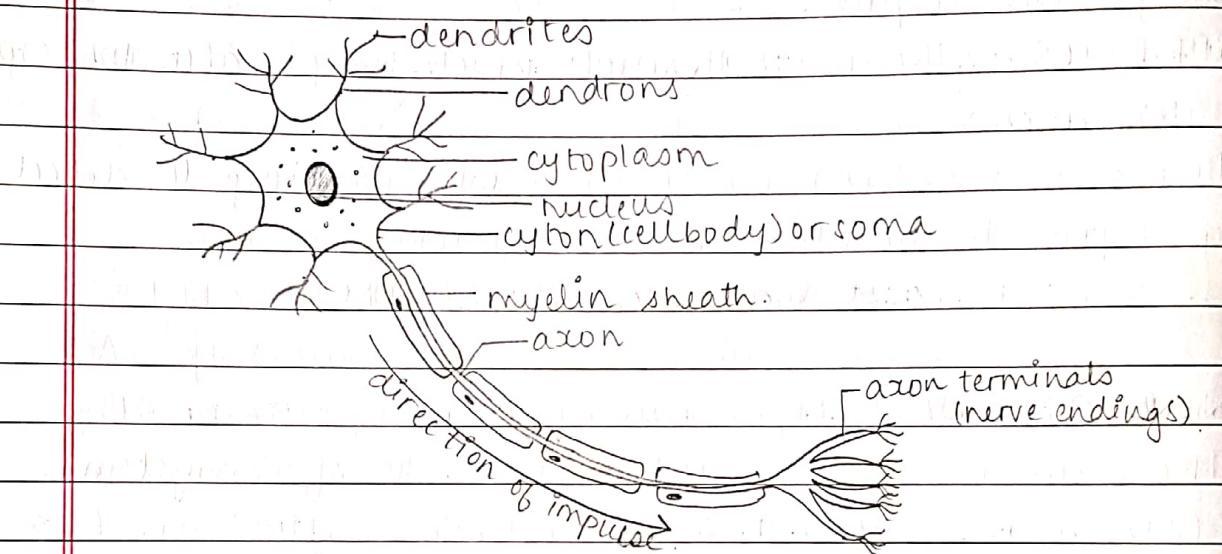
Two organ systems are continuously working to detect & respond to stimuli - NERVOUS SYSTEM

- ENDOCRINE SYSTEM

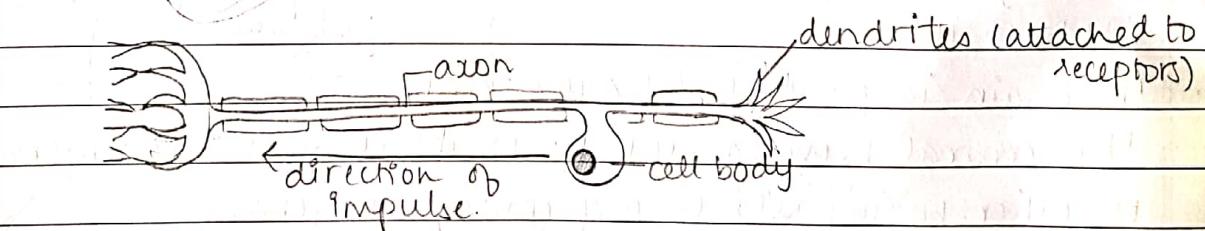
- NERVOUS SYSTEM:
- The human nervous system is made of 2 systems.

- CENTRAL NERVOUS SYSTEM:
 - It is made up of brain & spinal chord.
 - The spinal chord is basically a big bundle of nerve cells running through a tunnel inside the backbone which protects it.
 - The brain is protected by the skull.
 - The central nervous system is what gives out orders to other body parts to perform certain jobs.

- PERIPHERAL NERVOUS SYSTEM:
 - The nerves which connect the body to the CNS make up the peripheral nervous system.
 - The main job of the PNS is to detect stimuli & send impulses to the CNS according to the stimuli.



Motor neuron - longest cell in the body.

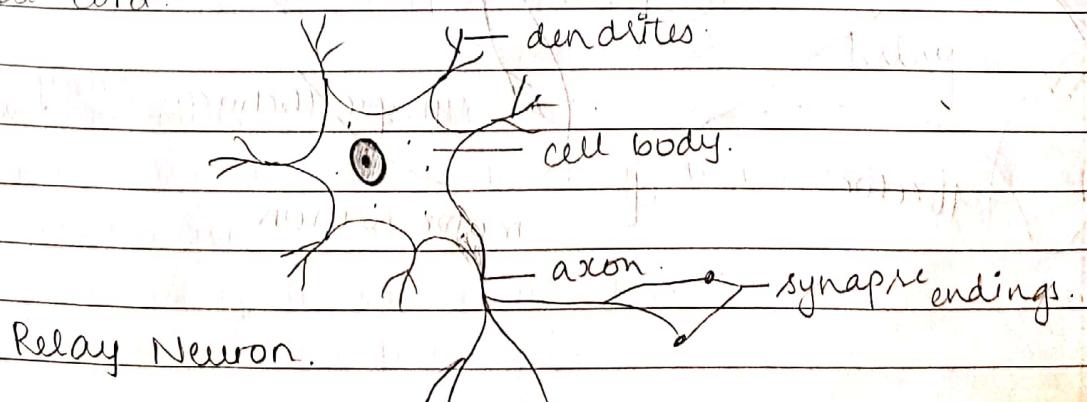


Sensory Neuron

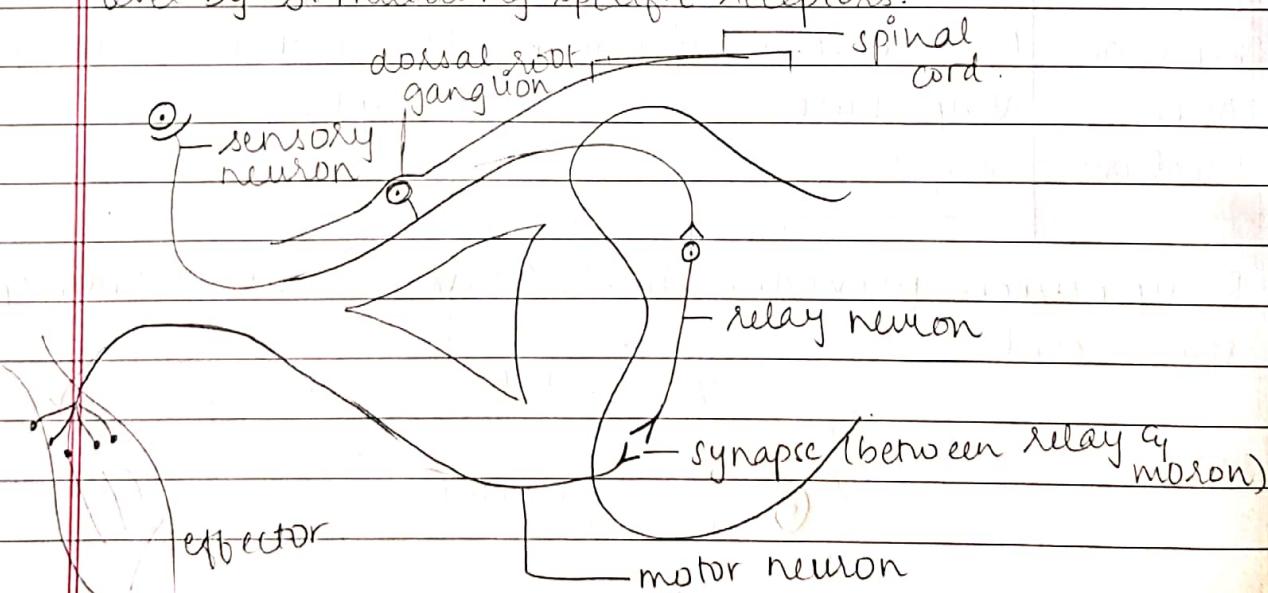
- Nerve impulses from CNS to the effectors, resulting in action are called motor impulses. These are transmitted by motor neurons.
- Nerve impulses from sense organs to the CNS are called sensory neurons. These are carried/transmitted by sensory neuron.
- Motor & sensory neurons are covered with a myelin sheath which insulates the neuron to make transmission of the impulse more efficient.
- The cytoplasm (mainly axon & dendrons) is elongated to transmit the impulse for long distances.

STRUCTURE	SENSORY NEURON	MOTOR NEURON.
Cell body.	Near end of neuron outside the spinal cord	Near start of neuron inside the grey matter of spinal cord
Dendrites	Present at end of neuron.	Attached to cell body.
Axon	Very short	Very long.
Dendron	Very long	None.

- Relay neuron provides 'link'. It is present in brain & spinal cord.



- **SYNAPSE:** (place where synapses are formed).
- The regions where impulses are able to cross from one neuron to next are called synapses.
- At a synapse, a branch at the end of one fibre is in close contact with the cell body or dendrite of another neurone.
- When an impulse arrives at the synapse, synaptic vesicles release a substance called neurotransmitter substance which sets off an impulse in the next neuron.
- ⇒ **REFLEX ARC (Nervous system in Action):**
- A reflex action is an automatic response to a stimulus. The nervous pathway for such reflexes is of an electrical impulse is called a reflex arc.
- Precise defn: spontaneous automatic, involuntary nerve mediated activity produced at the unconscious level by stimulating specific receptors.



- When a stimulus is detected by receptor cells, an electrical impulse is generated. These impulses are then carried by the sensory neuron to the CNS.
 - At the CNS the electrical impulses travel through the synapse to the relay neuron which passes it into the motor neuron.
 - The nerve impulses are transmitted through the axon of the motor neuron to the targeted muscle which acts upon reacts to the stimulus.
- ⇒ VOLUNTARY & INVOLUNTARY ACTIONS:
- Voluntary Action - Action that we chose to make. Eg: moving our hands or legs.
 - Involuntary Action - Action that we do unconsciously. Eg: sneezing, digestion.
- Involuntary actions are also known as autonomic/nervous.

⇒ EFFECTORS, BICEPS & TRICEPS:

→ Effectors are mostly muscles & glands.

→ Examples of effectors are biceps & triceps.

→ When the arm is bent - biceps contract
triceps relax

When the arm is straight - triceps contract
- biceps relax

Antagonistic
pair of muscles

↓
They have opposite
effects when they
contract.



HUMAN EYE:

- The human eye is a sensory organ. It detects & responds to specific stimuli, that is light.
- The eyebrow stops sweat running down the eye.
- Eye lashes help to stop dust blowing on to the eye.
- Eyelids can close automatically (blinking is a reflex) to prevent dust & other particles getting on to the surface of the cornea.
Blinking also helps to keep the surface moist by moving liquid secretion over the exposed surface.

→ Features of Human Eye:

- Lens: transparent structure.
flexible & can change its shape to focus on retina
- Ciliary muscles: It's in the front part of choroid.
It contracts & relaxes to adjust thickness
of the lens while focusing
- Suspensory ligaments: A ring of fibres.
Loosen & tighten to adjust thickness of
lens & hold lens in place
- Iris: Widens & narrows to control amount of light entering the eye depending on the light intensity.
- Choroid: Middle layer surrounding the eye.
Contains many blood vessels.
Has pigment to absorb light & stop reflection
The pupil looks black because all the light entering
the eye is absorbed by the black pigment in choroid.
- Sclera: Outermost, tough, protective, white layer.
The front part of the sclera is clear & allows light in
- Cornea: The clear part of sclera is this
- Retina: Innermost layer
Sensitive to light
Contains light responding cells. (cones & rods)
- Blind spot: Where the optic nerve touches the eye.
No light sensitive cells here
- Fovea: Region of eye with the highest concentration of cones
& lowest concentration of rods.
- Conjunctiva: Thin epithelium which lines the inside of the eyelids & the front of the eye
- Vitreous Humour: Jelly like liquid behind the lens.
- Aqueous Humour: Watery liquid in the front of the lens.

- Pupil: Hole in the centre of the iris that lets in light to the rest of the eye.
- Tear Glands: Under the top eyelid (lacrimal glands) Produce tear fluid Contains lysozyme (enzyme) to kill bacteria
- Yellow spot: Most sensitive part of retina

Cells	Function	Distribution	Comments
Rods	Sensitive to low light intensity. Detect shades of grey.	Found throughout retina but none in the centre of fovea or in the blind spot.	Provide us with night vision when we can recognise shapes but not colours.
Cones	Sensitive only to high light intensity Detect colour (don't operate in poor light)	Concentrated in fovea	These are three types sensitive to red, green & blue

→ ACCOMMODATION OF EYE:

→ The amount of focusing needed by the lens depends on the distance of the object being viewed - light from near objects requires a more convex lens than light from distant objects.

→ DISTANT OBJECTS:

- The ciliary muscles relax, giving them a larger diameter
- The pulls the suspensory ligaments. suspensory ligaments pull the lens
- The lens becomes thinner/narrower.

→ NEAR OBJECTS:

- The ciliary muscles contract, giving them a smaller diameter
- This removes the tension on the suspensory ligaments. Pulling on lens stops.
- The lens becomes thicker/widens

⇒ PUPIL REFLEX:

- This reflex changes the size of the pupil to control the amount of light entering the eye.
- Too much light is dangerous for rods & cones, which detect the light intensity.
- They start a reflex arc which make the radial or circular muscles relax or contract.

Light	Radial Muscles	Circular muscles	Pupil
Bright	relaxed	contracted	constricted
Dim	contracted	relaxed	dilated

- * Circular muscles - run around the iris
- Radial muscles - from centre to outside

⇒ THE HORMONAL / ENDOCRINE SYSTEM:

HORMONES are chemical substances produced by a gland, carried by the blood which alters the activity of one or more target organs & is then destroyed by the liver.

Hormones are produced in organs called ENDOCRINE GLANDS which make up the ENDOCRINE SYSTEM

⇒ COMPARING both the systems:

FEATURE	NERVOUS	ENDOCRINE / HORMONAL
Form of transmission	Electrical impulses	Chemical (hormones)
Transmission	Nerves.	Blood vessels.
Pathway		
Speed of transmission	Fast	Slow
Response	Localised	Widespread (but specific)
DURATION OF EFFECT	Short term	Long term.

* Endocrine system is the only system whose organs aren't connected physically

→ THE GLANDS:

→ Pineal gland

→ Hypothalamus

→ Pituitary gland

→ Thyroid gland

→ Parathyroid glands

→ Thymus gland

→ Adrenal gland

→ Pancreas

→ Ovary (in females)

→ Testis (in males)

⇒ ADRENALINE

→ Adrenaline is a hormone secreted by adrenal glands.

→ Adrenaline's main objective is to increase the metabolic rate so that the body could cope up with fight situations.

→ During a fight situation:

- Adrenaline is secreted. Its one of the target organs is heart
- It increases the heart rate so that oxygen could be supplied more quickly & more energy could be produced
- It contracts blood vessels in skin & digestive system so that they carry very little blood & more blood could be supplied to vital organs (heart & muscles). This is called VASOCONSTRICTION.

- It widens the arterioles in the brain & muscles so that they can carry enough blood. This is called VASODILATION.

- It stimulates liver to convert glycogen to glucose. This glucose is released into blood by liver. More glucose for the muscles would help them contract faster.
- It also dilation of airways.

→ CO-ORDINATION & RESPONSE IN PLANTS:

TROPISMS are responses by part of a plant towards or away from a stimulus coming from one direction.

The movement is always a GROWTH MOVEMENT

Plants respond to their environment much slowly

→ PHOTOTROPISM: The response in which the plant grows towards or away from

→ GEOTROPISM: The response in which the plant grows towards or away from gravity.

→ POSITIVE TROPISM: If growth is towards the stimulus.

NEGATIVE TROPISM: If growth is away from the stimulus.

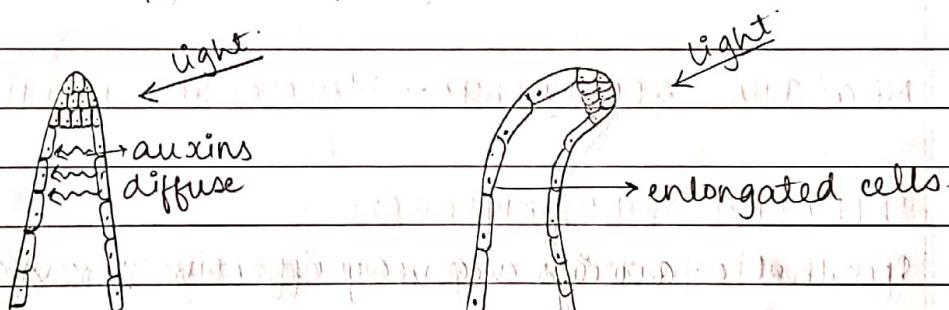
Plant Part	Geotropism	Phototropism
shoot	Negative	Positive
root	Positive	Negative

⇒ **AUXINS:**

- Auxin is a plant hormone. It controls the tropisms. It is produced by cells at the tip of roots & shoots.
- Auxin CAUSES cell elongation in SHOOT ROOT
- Auxin PREVENTS cell elongation in ROOTS

→ **AUXIN IN PHOTOTROPISM:**

- If a shoot is exposed to light from one side:
- The auxins produced by the shoot tip diffuse away from the light, that is towards the shaded area
- On this side shoot cells are caused to elongate. Hence, this side of the plant grows faster
- As a result, the shoot/plant bends towards the light
- This is positive phototropism.



→ **AUXIN IN GEOTROPISM:**

- Auxins tend to settle at the bottom end of the root
- They prevent the growth & elongation of the cells at the tip.
- The cells in the middle of root grow faster & push the root deeper into the soil make the root longer
- This is positive geotropism.

→ ADVANTAGES OF TROPISMS:

- POSITIVE PHOTOTROPISM - Helps get maximum light for photosynthesis
 - Flowers can be seen by insects for pollination.
 - Plant gets better seed dispersal

→ NEGATIVE PHOTOTROPISM - Less chance of drying out

- POSITIVE GEOTROPISM - By growing deeply into the soil, the root fixes the plant firmly to soil
 - Roots are able to reach more water
 - Roots get larger surface area for more diffusion of osmosis
- NEGATIVE GEOTROPISM - More chance for finding light

→ SELECTIVE WEED KILLERS:

- Synthetic auxins are very effective as selective weed killers.
- Important cereal crops like wheat & barley are narrow leaved (monocotyledonous) whereas most of the weeds that compete with them for water, nutrients & light are broad leaved (dicotyledonous).
- Auxins are sprayed on the crops but tend to run off the leaves of the cereal plants because they are thin & point upwards.
The weedkillers are more likely to be absorbed by the broad leaved weeds

→ The auxins increase the growth rate of the weeds! The weeds cannot provide enough food from photosynthesis to maintain this growth & soon die.

→ HORMONES IN FOOD PRODUCTION:

- Farmers sometimes use hormones to
 - increase the growth rate of their animals. or
 - ability to produce some products (eg milk)

→ BST (Bovine somatotropin) is a protein hormone produced by cattle.

→ If cows are given extra BS, they produce 20% more milk.

→ This means that the milk yield would increase & so would farmer's profits. Also fewer cows would be needed for same amount of milk.

→ However, there are concerns also:

- Some people are worried about drinking BST treated milk thinking that it might damage their health. However, this shouldn't be a concern because BST gets into the milk only in tiny quantities.
- The BST might harm the cows.
 - BST treated cows become infertile.
 - BST treated cows may develop mastitis (inflammation of udders)
- There could be lot of surplus milk produced.