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CONTROL AND COORDINATION

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» The process of working together of various parts of the body in a regulated manner and in efficient way to produce proper response to various stimuli is known as coordination.

Types of Coordination

Nervous	Hormonal
» Electric signals	» Chemical signals
» Only in animals	» Both plants & animals
» Fast response	» Slow response (for uniform growth)

Nervous System

Central Nervous System

» • brain
• Spinal cord

Peripheral Nervous System

» • Cranial nerves (brain)
• Spinal nerves (spinal cord)

PERIPHERAL

Types of Nerves

1. On the basis of process
   ① Sensory nerves - Bring message toward Brain
   ② Motor nerves - Take message from Brain to the effector (muscle/gland)

2. On the basis of action

- Somatic
  - Voluntary action
- Autonomic
  - Involuntary actions
    - Sympathetic
      - Excites the body
      - Examples:
        - Dilates pupil
        - Heart rate ↑
        - Palpitation ↑
        - Shivering
        - Sweating
        - Dry mouth
    - Parasympathetic
      - Calms down
      - ⇒ Everything becomes normal

RECEPTORS

1. Smell (Nose) – Olfactory receptors
2. Sight (Eyes) – Photo receptors
3. Taste (Tongue) – Gustatory receptors
4. Hear (Ears) – Phono receptors or Auditory receptors
5. Touch (Skin) – Thermo receptors

NERVE CELL – Neuron

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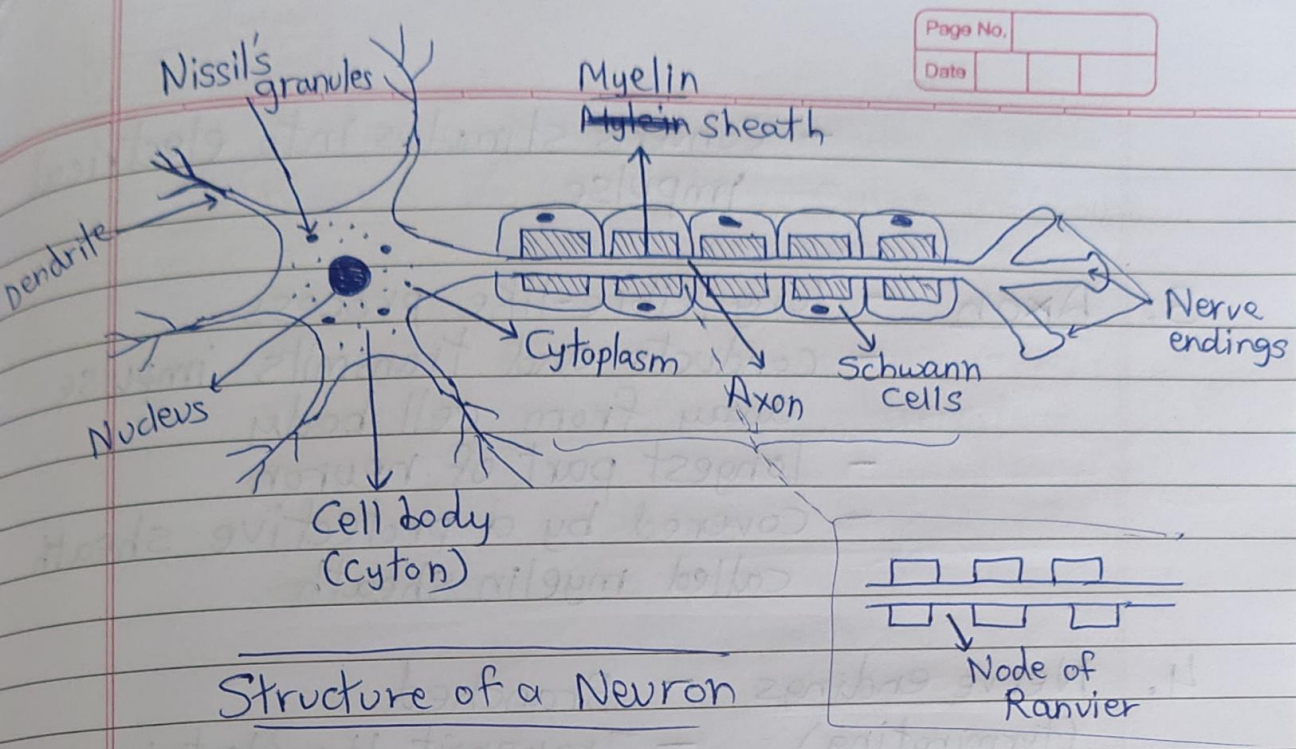
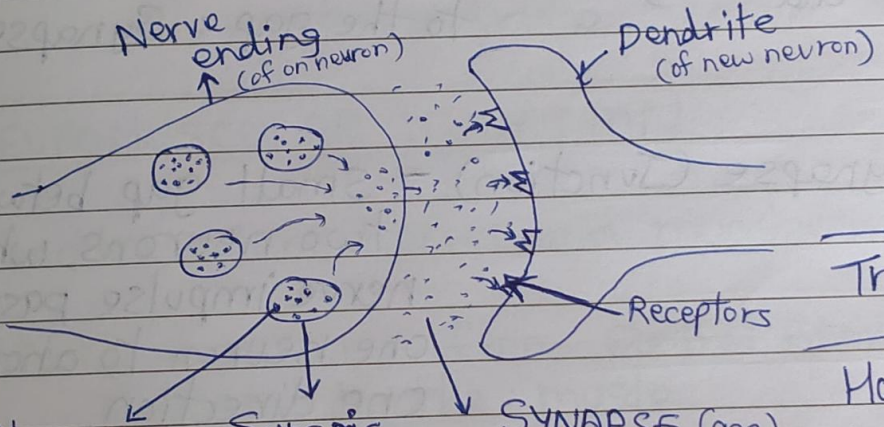


Structure of a Neuron



Transmission

How message is passed

Common – Acetychloine (Chemicals)

UNIDIRECTIONAL →

1. Dendrite – Branched
   – Receive and transmit electrical signals
2. Cell body (Cyton) – Broad, rounded part of neuron with nucleus, abudant cytoplasm

- Converts stimulus into electrical impulse.

3. Axon
   - long, fibre-like process
   - conducts and transmits impulse away from cell body
   - longest part of neuron
   - Covered by a protective sheath called myelin sheath

4. Nerve endings (terminating end)
   - Branched
   - Transmit the electric signals to the gap : Synapse

Synapse (Junction) - small gap between two neurons, when nerve impulse passes from one neuron to another in one direction.

TRANSMISSION OF NERVE IMPULSE

Information from environment
↓
Detected by receptors
↓
Transferred to sensory neurons
(located in sensory organs such as inner ear, nose, tongue, eyes, etc.)
↓
Reaches dendrons/dendrites
(causes chemical reaction and produces electric impulse)

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↓

Travels and reaches Cyton (cell body)

↓

Axon

↓

Terminal ends (release chemicals - Neurotransmittors)

↓

Crosses the gap (Synapse)

↓

Starts similar electric impulse in next dendrite

NEUROMUSCULAR JUNCTION

» Junction where nerves and muscles meet

Motor ~~nuve~~ neuron from Central nervous System to the muscle

↓

Releases neurotransmitters for transmission of nerve impulse

↓

From neuron to muscle cell/fibre

Limitations of using Electric Impulse

1. Reaches only to cells connected to the nervous tissue, not each and every cell.

2. The cells after transmission of impulse takes some time to reset its mechanism to transmit

a new impulse.
(Neurotransmittors exhaust due to continuous transmission / transfer of impulse)

Eg - We cannot smell perfume of our own body

REFLEX ACTIONS

Protective measures
Time savers

Eg - Coughing
Sneezing

- Automatic and rapid response to stimulus
- Message is passed to Motor Neuron through the Relay Neuron
- The spinal cord sends the message till the effector

REFLEX ARC

- The pathway taken by the nerve impulse in a reflex action is called reflex arc.

Stimulus
↓
Sense organs
↓
Sensory / Afferent / Receptor Neuron
↓
Central Nervous System
↓
Motor / Efferent / Effector Neuron

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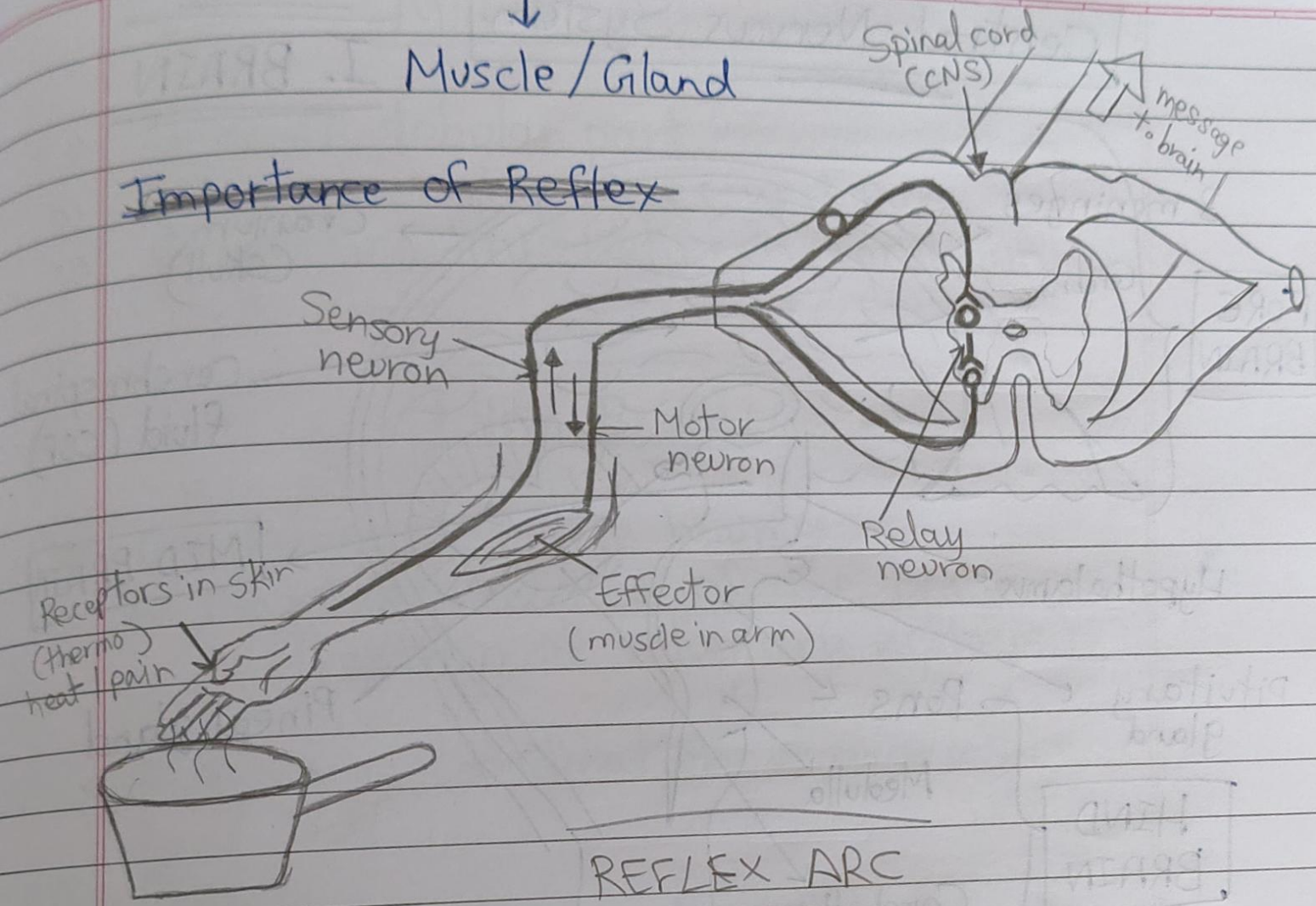
↓

Muscle / Gland

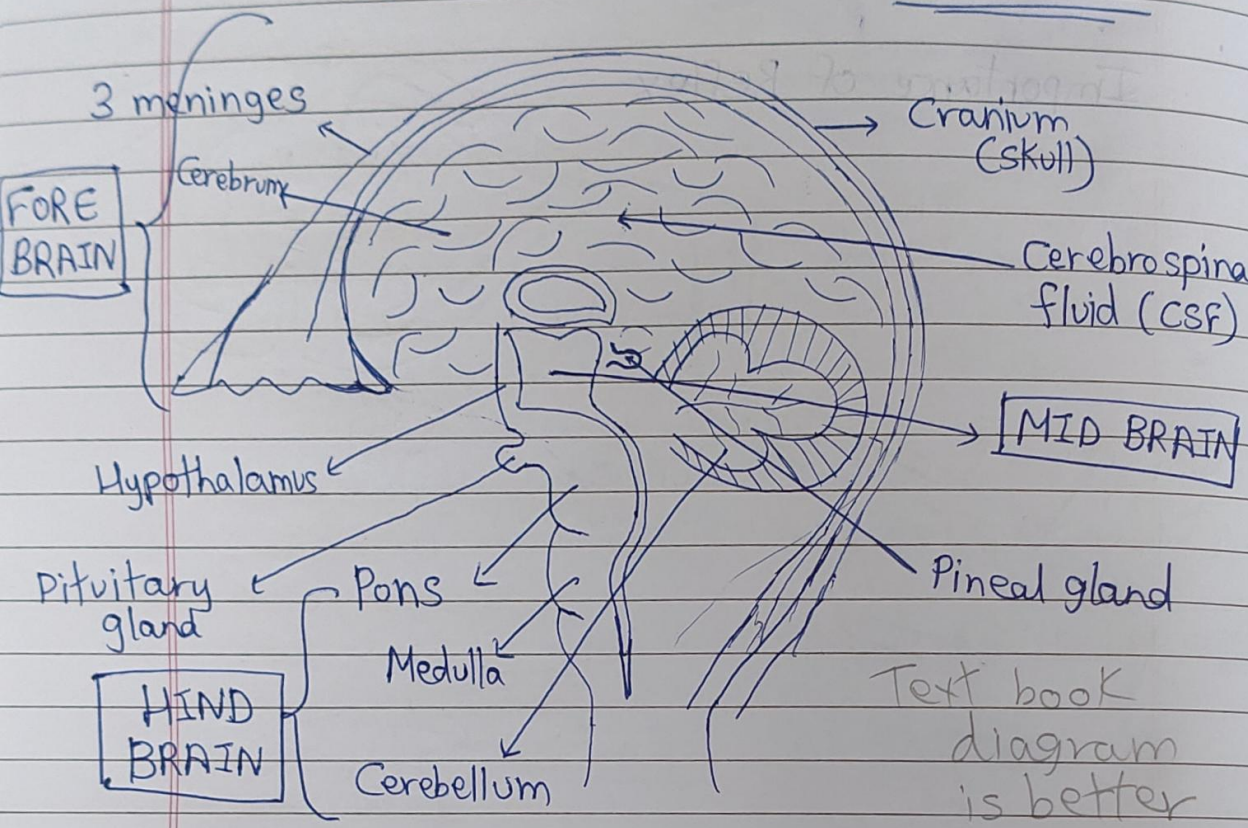
~~Importance of Reflex~~



REFLEX ARC

Central Nervous System

I. BRAIN



Text book diagram is better

Fore Brain

CEREBRUM

- Voluntary actions
- Largest part of the brain
- Think
- Invent
- Plan
- Memorise
- Reasoning
- Logic
- Emotions

OLFACTORY LOBES

- Smell

DIENCEPHALON

- Hypothalamus
- Thalamus
- Epithalamus

- Thermo regulator
- Sweat
- Thirst
- Hunger
- Sateity (feeling of fullness)

Mid Brain

- A small tubular part
- Reflex involving eyes and ears
- Connecting link between forebrain and hind brain.

Hind Brain

(i) Cerebellum: (little brain)
- Maintains balance of the body (Precision of voluntary actions)
- Helps in coordination of muscles

(ii) Pons:
- Located in the centre of the brain below cerebellum.
- Carries impulses from one hemisphere to other
- Helps in respiration

(iii) Medulla:
- Its further extention merges with spinal cord
- Lowest portion of brain
- Helps in involuntary processes like:

>>>>

- Sneezing
- Salivation
- Swallowing
- Coughing
- Vomitting
- Controlling BP
- Expansion and Contraction of blood vessels
- Breathing movements

COORDINATION IN PLANTS

Plants:

»» No nervous system / muscle tissue
»» Use chemical means to convey information

1. Immediate Response:
   (a) Use electro-chemical means to convey information from cell to cell.

   (b) Cell of the plant change its shape by changing the amount of water, resulting in swelling / shrinking of cell.

2. Movement due to growth:
   »» Respond to stimulus by growing in a particular direction.

   Eg - Pea, Pumpkin, Cucumber (climbers / creepers)

»» Tendrils

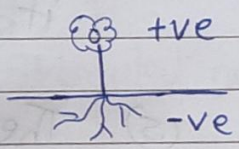
»» The part of the tendril in contact with the object does not grow as rapidly as the part away from the object.

Movement due to growth

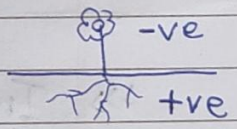
Tropic Movement	Nastic Movement
»» directional growth (either towards or away from the stimulus)	»» No fixed direction (does not show growth but shows immediate response)

Types of Tropic Movements

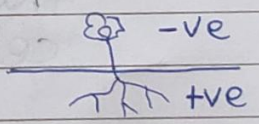
1. Phototropism [stimulus - light]



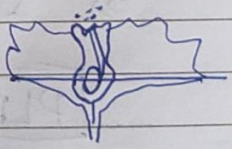
2. Hydrotropism [stimulus - water]



3. Geotropism [stimulus - gravity]



4. Chemotropism [stimulus - chemicals]
growth of pollen tube towards the ovary



5. Thigmotropism [stimulus - touch]
They are touch sensitive
Eg - 'Touch Me Not' plant

CHEMICAL COMMUNICATION

Hormones are chemical messengers.

(1) Cells cannot continuously create and transmit electric impulse.

↓

(2) So, most multicellular organisms use chemical communication.

↓

(3) Instead of electrical impulse → Chemical compound is released and it gets diffused in the cell.

↓

(4) Other cells detect the chemical compounds using special molecules → Recognise it → and transmit the information.

↓

(5) These chemical compounds are HORMONES.

+ »» In Hormones, the transmission is slower than electric impulses but reaches all cells, regardless of nervous connections.

»» It is a slow and steady process.

PLANT HORMONES known as Phytohormones

»» 2 types:

- Promoters
- Inhibitors

>>>

Plant Hormones

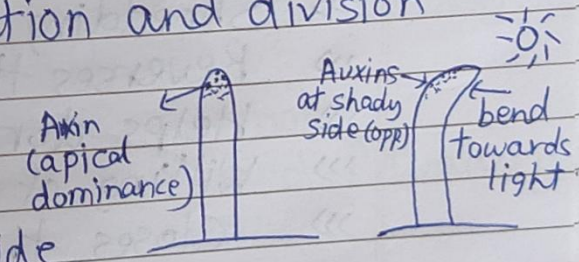
Promoters	Inhibitors
① Auxin	④ Abscissic Acid (ABA) (stress hormone)
② Gibberellins	⑤ Ethylene (gaseous)
③ Cytokinins	

PROMOTERS

1. **Auxin** [Growth hormone]
   - Promotes apical growth
   - Synthesised in young tips of roots and shoot
   - Present at the tips of roots and shoot
   - Helps them to grow longer
   - Plants show bending towards the sunlight because auxin diffuses towards the shady side of the shoot → Stimulating the cells to grow longer.

Functions:

1. Promotes cell elongation and division
2. Growth of plant
3. As auxin diffuse towards the shady side, so that part elongates more. So shoot bends towards light and helps in phototropism.



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2. Gibberellins
- Helps in the growth of stem
- Delays senescene (aging)

3. Cytokinin
cell division
- Promotes new leaves
- Lateral growth
- Overcomes apical dominance
- Delays ageing in the leaves
- Stimulates leaf expansion
- Helps in opening of stomata
- Breaks dormancy of seeds/buds. (the 'sleepy mode')

INHIBITORS

4. Abscissic Acid (ABA) [Stress Hormone]
Stress of heat, temperature, water, etc. present in plants. So, ABA helps in:
- Shredding of leaves
- Reverses the growth
- Helps dormancy of seeds
- Wilting of leaves (in absence of water)
- Closes the stomata to avoid water loss under drought conditions

5. Ethylene [Ethene]
- Gaseous hormone (the one and only)
- Known as "ripening hormone."
- Promotes senescence

» Ascission (shedding) of leaves
» Promotes cell division (like cytokinin)

Human Hormones

Glands

Endocrine	Exocrine
» Ductless glands » Pour their secretions directly into the blood stream	» Has ducts » Pour their secretion into blood through ducts.

Pancreas
both endo- and exo-crine
∴ Known as:
- Compound gland
- Metrocrine gland

1. Hypothalamus gland [Forebrain (Deincephalon)]
» "Super Master Gland"
» Releasing and inhibitory hormone
» Controls body temperature and Pituitary gland

2. Pituitary Gland
» "Master gland"

(a) Growth Hormone (GH) — Hypersecretion, Hyposecretion

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»» Hypersecretion - over secretion ↑
- Gigantism

»» Hypo secretion - under secretion ↓
- Dwarfism

(b) Thyroid Stimulating Hormone (TSH)
»» Regulates the secretion of hormone from thyroid gland

(c) Follicle Stimulating Hormone (FSH)

Male (sperm) Female (ova) - (Stimulated)

3. Thyroid Gland

»» Largest Endocrine Gland
»» Present between Larynx and Trachea
»» Releases Thyroxine (hormone)
[and Calcitonin (not in syllabus)]

Hypersecretion - over active ↑ (Thyroxine)
- Basal Metabolic Rate increases ↑ (BMR)
Faster heart rate, BP, digestion and all metabolic activities
↓
Person becomes thinner

Hyposecretion – Under secretion ↓
– Low Thyroxin ↓ is released
– BMR decreases ↓
– Causes Goitre

»» If iodine is deficient in our diet then there is a possibility of suffering from Goitre.

[Iodine ↑ – Thyroxin ↑
Iodine ↓ – Thyroxin ↓ – Goitre]

4. Pineal gland

»» Releases Melatonin (hormone)
»» Controls sleep cycle
»» Responsible for biological clock

5. Pancreas

»» Found in the loop of Deudenum (first opening of small intestine)

»» Releases

Insulin

»» Released by β-cells (Beta cells)

»» Decreases the blood glucose level

Glucagon

»» Released by α-cells (alpha cells)

»» Increases the blood glucose level

>>>

Excess sugar → stored as → Glycogen

↓ in

Liver

↓ breakdown

Glucose

»» During fasting, the stored glycogen breaks down into sugar and thereby increases blood sugar level in the body. This is its feedback mechanism.

⇓

Feedback Mechanism (regulates hormone actions)

Carbohydrates-rich meal

↓

Increases glucose level in blood

↓

β-cells in Pancreas release Insulin

↓

Insulin stimulates the cells to take up Glucose

↓

Glucose level falls in the blood (↓)

↓

Insulin secretion is reduced

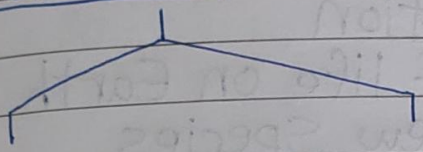
6. Adrenal Gland

»» Releases Adrenaline

»» Prepares the body to "fight" or "flight" from the situation.

- Makes heartbeat faster
- Dry mouth
- Thrumping of heart
- Shivering
- etc. (same as Sympathetic Nervous system)

7. Gonads [Reproductive hormones]



Testes	Ovaries
↓ secretes	↓ secretes
• testosterone	• Oestrogen • Progesterone

» Regulates the changes associated with puberty.

» Development of secondary sexual characters
» Production of gametes

8. Thymus Gland

» This gland degenerates on Puberty (Develops immunity at early age)

» Releases Thymosin.