NERVOUS SYSTEM

NEUROLOGY → NERVOUS SYSTEM → Ectoderm

NERVOUS SYSTEM → Rapid in Action

COMPONENTS

1. RECEPTORS → Detect stimulus (Any change) ← Threshold stimulus.
2. NEURON → Conducting cell; Basic structural and functional unit
3. EFFECTORS → Respond against stimulas

RECEPTORS

RECEPTORS → Transducers (Stimulus → N·Impulse)

Cell, Neuron Endings, Organs

- EXTERO → Outside body
  - Eyes → Rods, Cons
- ENTERO → Inside body
  - Hypothalamus

NATURE OF STIMULUS

CHEMORECEPTORS → Blood (Gases, Amino Acids, Glucose)

Taste → Gustation

CHEMORECEPTORS → Hypothalamus

- Taste → Gustation
- Smell → Olfaction
- Water & Solute → Osmoreceptors

MECHANORECEPTORS → SKIN, EAR

- Touch, Pressure → Meisener's Corpuscles → Pacinian Corpuscles
- Equilibrium → Choclear fluid
- Hearing → Ear
- (Joints) → Vibrations → Proprioreceptors
- (Aorta) → Pressure → Baroreceptors

PAIN RECEPTOR → Nociceptors

Variable / Temporary → + Brain (No Pain) receptor

- Forehead, Fingertips
- Appendix → Appendicitis
- Testicles → male body
- Vagina → Temporary receptors.

PHOTORECEPTORS → Electromagnetic receptors

→ Light → Electromagnetic wave → Eyes

- Rods → Dim light
- Cons → Intense light

THERMORECEPTORS → Degree of Hotness & Coldness

HUMAN SKIN → Sensation (Hot, Cold, Pain, Touch, Pressure)

↳ Receptors (Hair follicles, Meisener's, Pacinian)

Pain ⟹ (27x) Cold ⟹ (10x) Hot

27 x 10 = (270x) ↑↑

EFFECTORS → Show respond against stimulus

- Muscles → Contraction, Relaxation
- Glands → Secretion
  - . Saliva Secretion
  - . Gastric Juice

NERVOUS SYSTEM

- 50% → NEURONS
  - . Chief structural unit
  - . Functional unit
- 50% → NEUROGLIA
  - . Nutrition
  - . Protection

. Chief structural unit
. Functional unit

. Protection
→ Schwan cells
→ Oligodendrite cells
→ Microglia

FUNCTIONAL
- Sensory Neuron
- Inter Neuron
- Motor Neuron

STRUCTURAL
- Unipolar Neuron
- Bipolar Neuron
- Multipolar Neuron

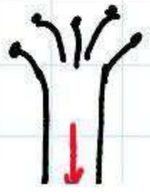
FUNCTIONAL CLASSIFICATION

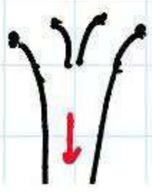
SENSORY
. Sense stimulus
Receptor → CNS
Afferent > Efferent
Dendrites > Axon
* Dendron > Axon

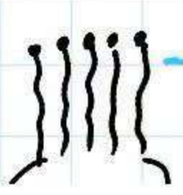
INTER
CNS
Brain Spinal cord
Afferent ≃ Efferent
Nearites

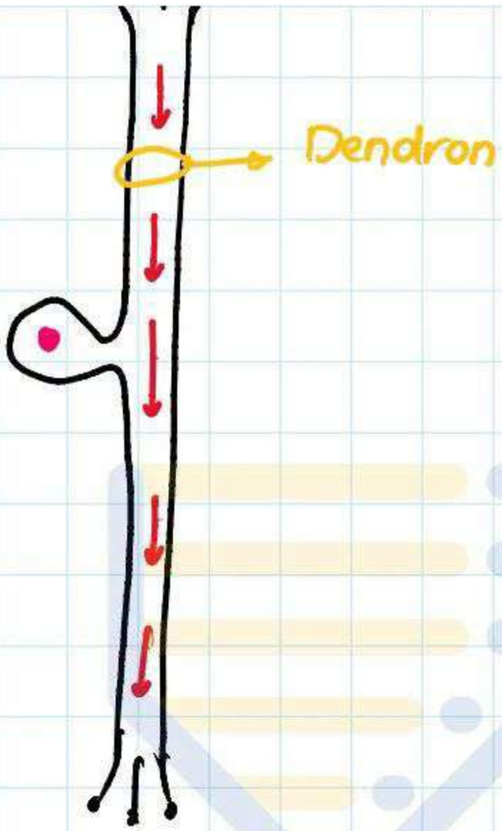
MOTOR
. Respond stimulus
. CNS → Effectors
Afferent < Efferent
Dendrites < Axon

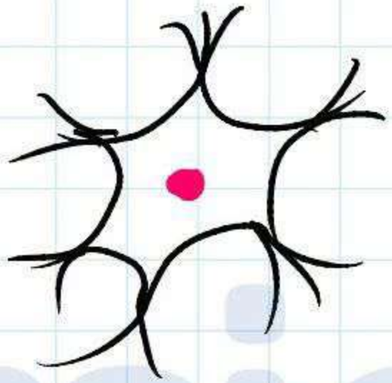
STRUCTURAL CLASSIFICATION

UNIPOLAR


BIPOLAR


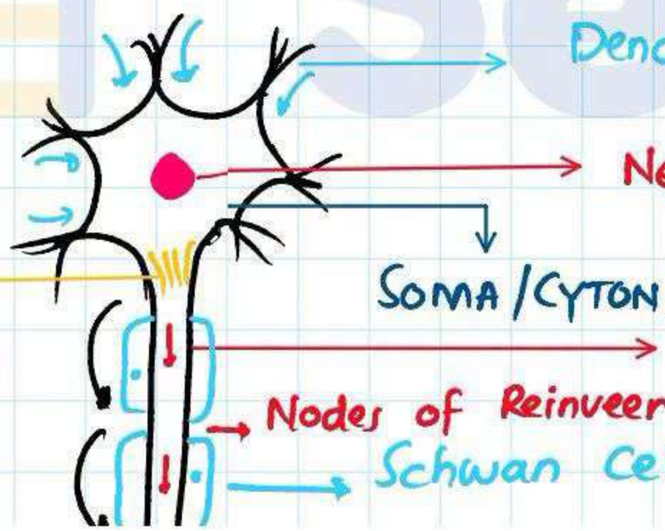
MULTIPOLAR






Inter-Neuron
Relay Neuron.

STRUCTURE OF NEURON



Dendrites

Nucleus (Prominent Nucleolus)

Soma / Cyton / Perikaryon

Axon Hillock

Axon (Constant diameter)

mm ⟶ 1meter

Nodes of Reinveer

Schwan Cells (Mylein Sheath)

* Centriole Absent

Mitochondria ↑↑

ATP ↑↑

ATP ↑

Energy Source → Glucose

Nissel's Granules

RER + G.A

ER Ribosome

Nodes of Ranvier

Schwan Cells (Mylein Sheath)

Non-myleinated → 100 ms⁻¹

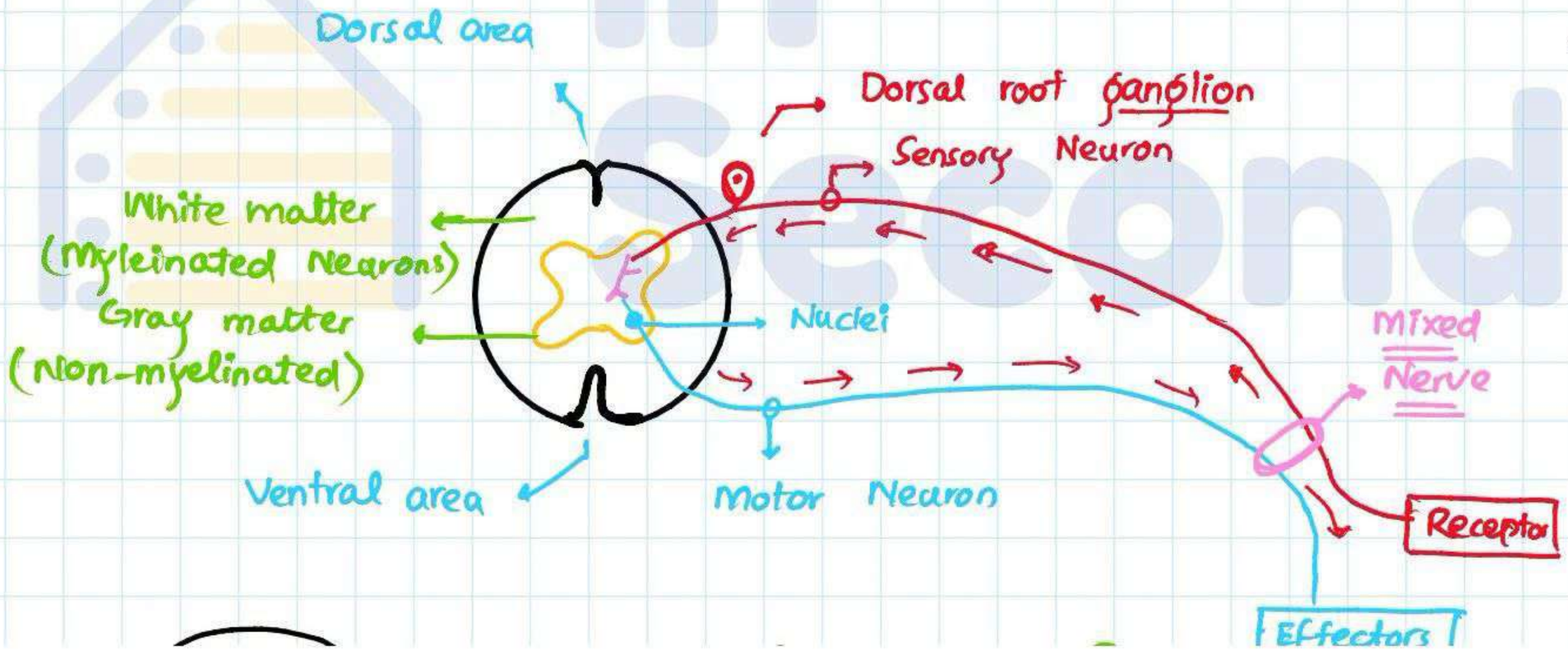
Myleinated → 120 ms⁻¹

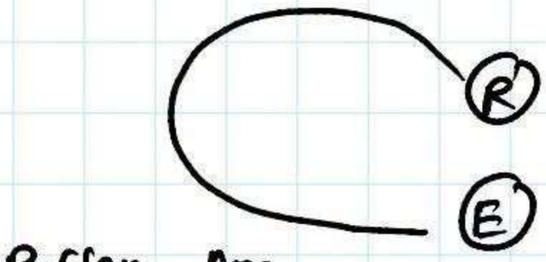
CNS (Oligodendrite) PNS (Schwan Cells)

Terminal knobs
(Peri-Synaptic knobs)

REFLEX ACTION → Spontaneous, Rapid Abrubipt

- immediate, autonomic & involuntary response
- Pathway of Nerve impulse → Reflex Arc





Reflex Arc.

- Components: (5)
  - → Receptors
  - → Sensory Neuron
  - → Inter neuron
  - → Motor Neuron
  - → Effectors

CLASSIFICATION:

INNATE / By Birth	Unconditioned Reflex ↳ No Learning Required	→	Suckling of milk
Acquired	Conditioned Reflex ↳ Learning Required	→	Salivation
STRUCTURAL	Cereberum, Mid Brain, Spinal cord	→	Eye Reflex
No. of Synapses	Monosynaptic (without inter Neuron) / Polysynaptic (↳ Inter Neuron)	→	Stretch Reflex
Functional	Flexors / Extensors	→	Flexion of elbow
Somatic / Autonomic	Somatic Nerves	→	Skeletal muscles
	ANS	→	Swallowing, Coughing

Somatic / Autonomic

ANS

→ Skeletal muscles

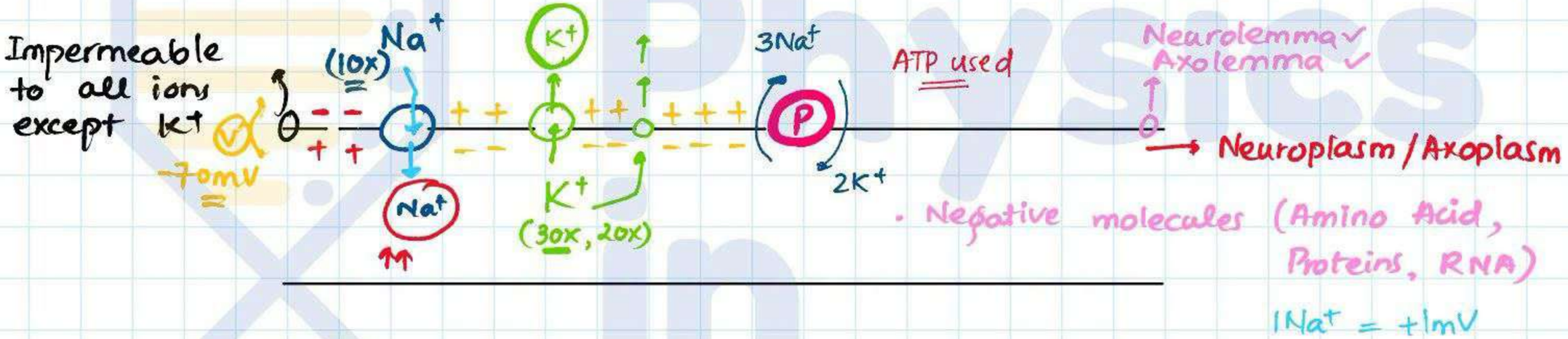
→ Swallowing, Coughing

NERVE IMPULSE

Wave of electrochemical change

. Unidirectional, Irreversible

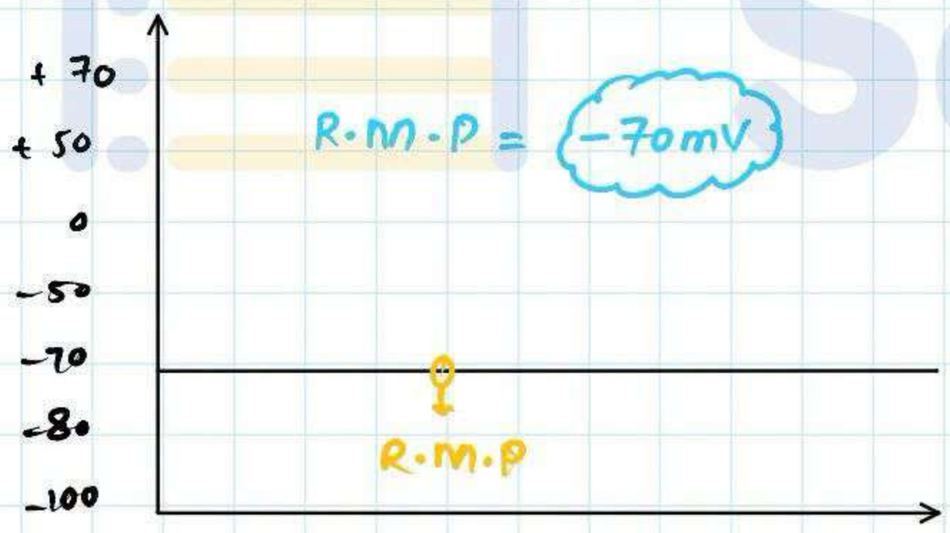
→ RMP (Rest) → AP (Nerve Impulse travelled)

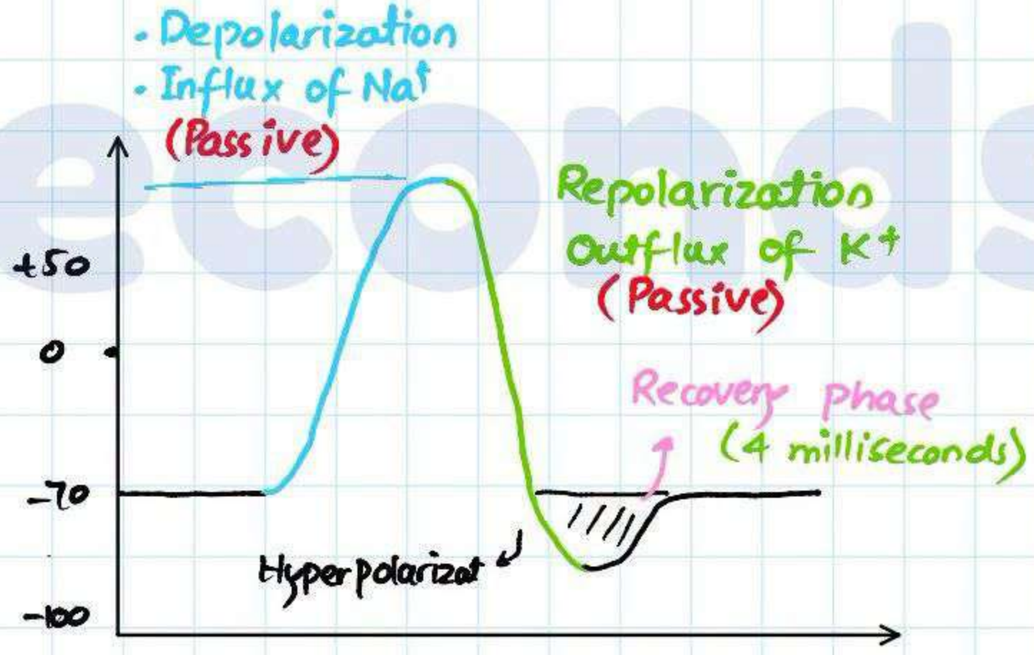


. Negative molecules (Amino Acid, Proteins, RNA)

$INa^+ = +1mV$

$-70mV \rightarrow +70mV$





FACTORS ⟶ Speed of Nerve Impulse

Temperature ∝ Nerve Impulse Speed
- ↑↑ Warm blooded
- ↓↓ Cold blooded

Axon diameter ∝ Nerve Impulse ⟶ Giant Squid

Mylein Sheath ∝

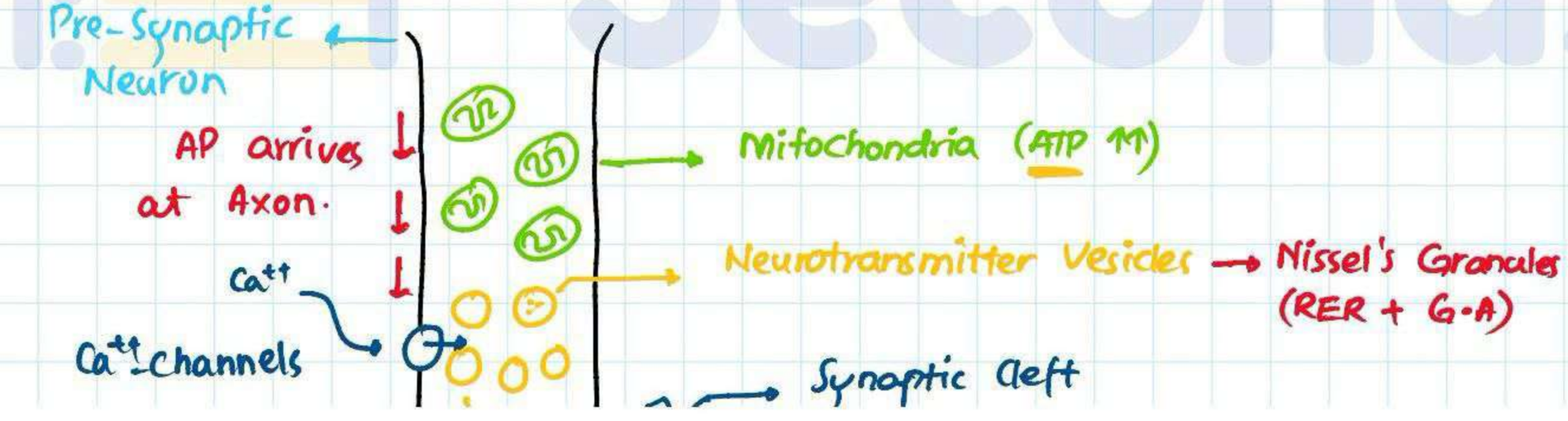
SYNAPSE ⟶ Connection b/w two conducting cells

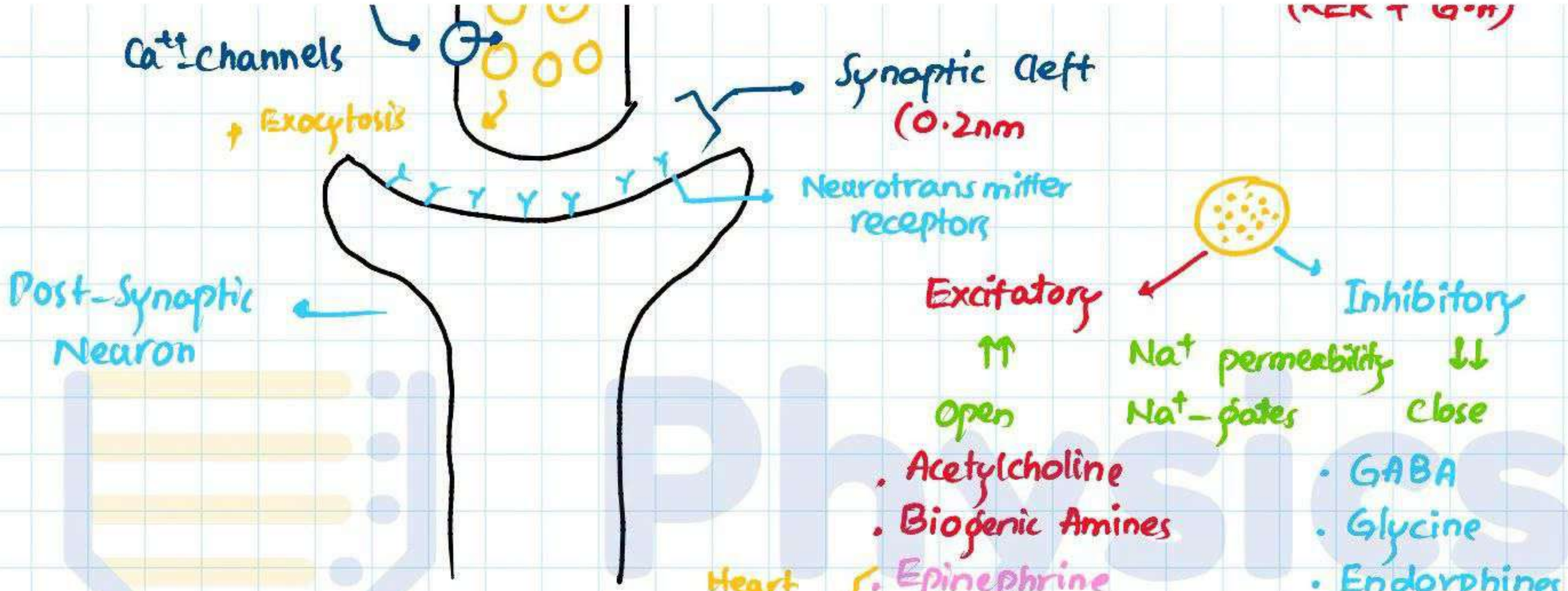
Axon ⟶ Dendrite

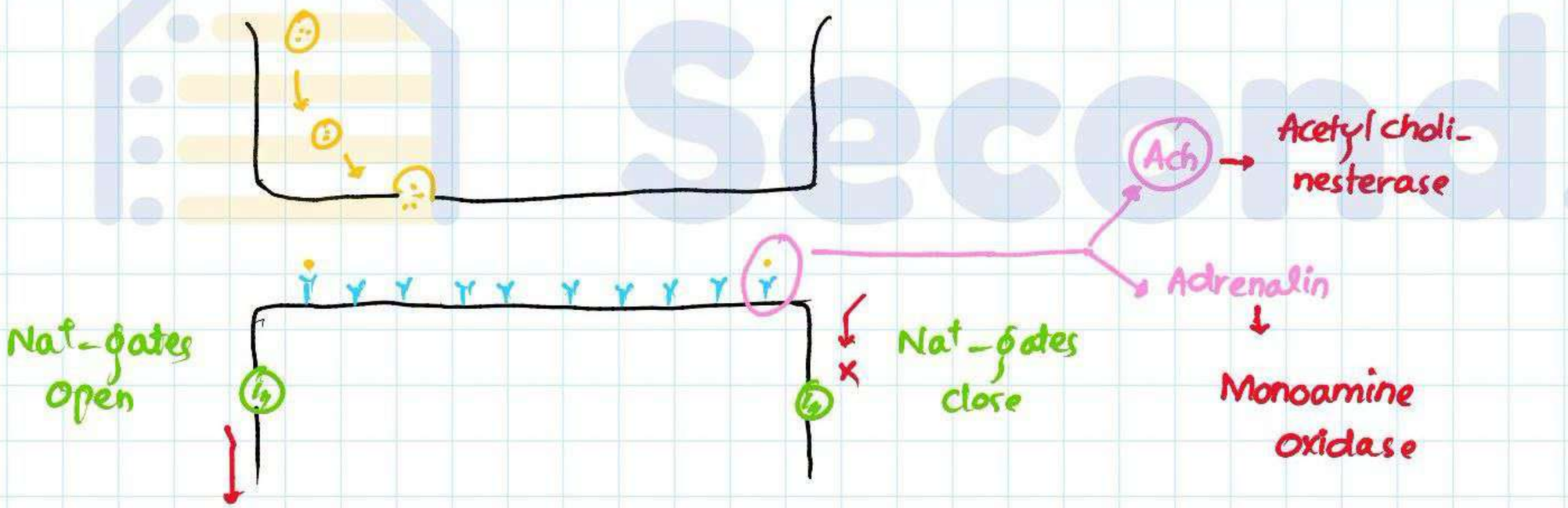
- Axon — Axon
- Axon — Dendrite
- Axon — Soma
- (Neuron — Muscle)

Discontinuous
Chemical

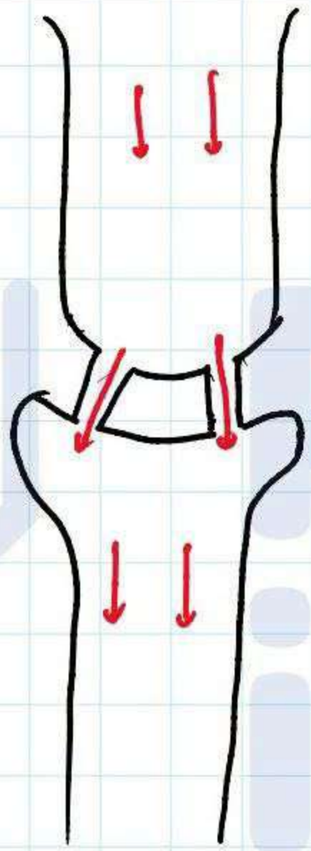
Continuous
Electrical




Ca^{++} channels
Exocytosis
Synaptic cleft (0.2nm
Neurotransmitter receptors
Post-Synaptic Neuron
Excitatory
Inhibitory
↑↑
Open
Na^+ permeability
Na^+-gates
↓↓
Close
. Acetylcholine
. Biogenic Amines
. GABA
. Glycine
. Endorphines
Heart Rate
. Epinephrine
. Nor-Epinephrine
Sleep Mood
. Serotonin
. Dopamin


Ach
Acetyl choli-nesterase
Adrenalin
Monoamine oxidase
Na^+-gates Open
Na^+-gates close

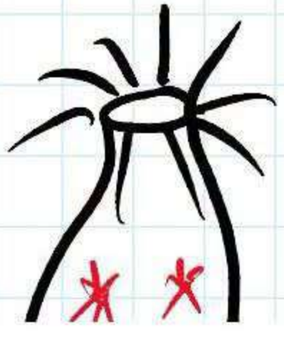
ELECTRAL SYNAPSE : Continuouse Synapse



- HEART
- BRAIN

EVOLUTION OF NERVOUS SYSTEM

Diffused → Colentrata Cnidaria



→ No Head

→ No differentiated Nearons

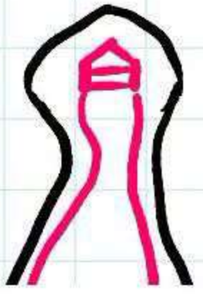
Centralized ← Platyhelminthese

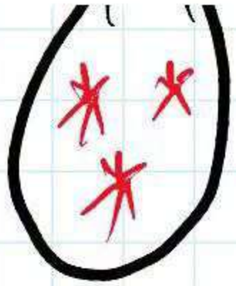
↓

Chordates

- Sensory
- Inter

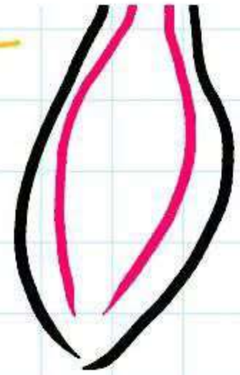
Head ←





→ No differentiated Nearons

. Sensory
. Inter
. Motor



NERVE — PNS

TRACT — CNS

Collection of Axons or dendrite

PNS ← GANGLIA NUCLEI → CNS

Collection of Somas / cell bodies

DIVISION OF HUMAN NERVOUS SYSTEM

- NERVOUS SYSTEM
  - CNS
    - BRAIN
    - SPINAL CORD
  - PNS
    - Motor Neuron
      - CNS → Effectors
      - Voluntary Function → SOMATIC N. SYS
      - Involuntary → AUTONOMIC N. SYS
    - Sensory Neuron
      - Sensory organs → CNS

SYMPATHETIC

- Fright
- Flight
- Fight

PARASYMPATHETIC

- Rest
- Rumination

CENTRALIZED N. SYSTEM

BRAIN

- Ventricles / Cavities
- Skull / Cranium

SPINAL CORD

- Central Canal
- Vertebral Column

SKELETAL SYSTEM

MENINGES

(Just beneath Cranium)

Outermost → D → Dura matter

Middle → A → Arachnoid matter

Innermost → P → Pia matter

(Just above brain)

Meningitis دماغ کا بخار

CEREBRO SPINAL FLUID

CSF

CO_2 ↓ ↑ Proteins, Glucose, Electrolytes

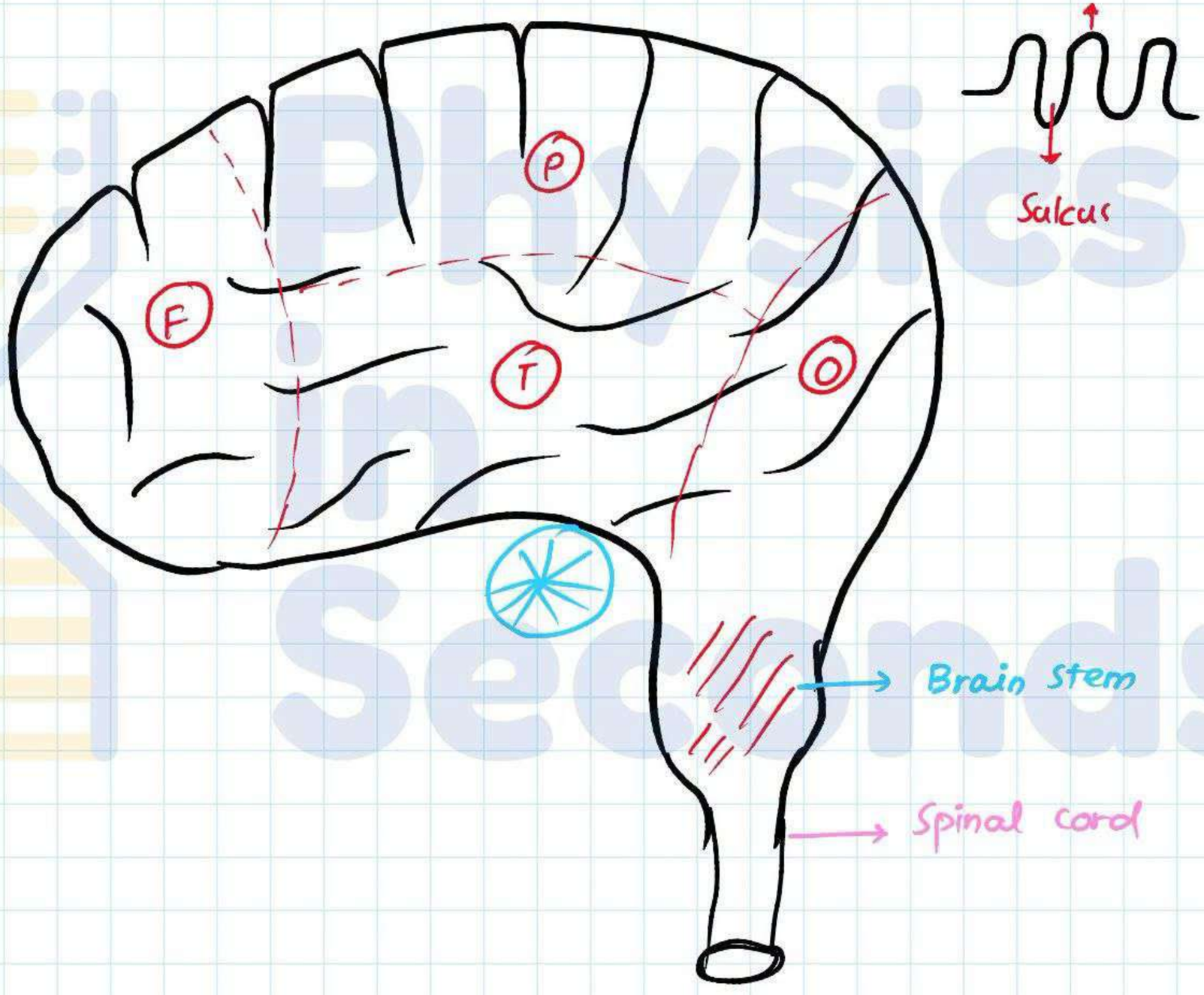
Prevents from bumps & jolt

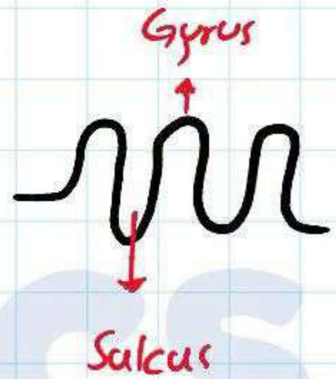
CEREBRO SPINAL FLUID

Prevents from bumps & jolt

150 ml *

BRAIN → 1200 – 1600 gm





FORE BRAIN

* largest part

THALAMUS

- Sensory information to limbic sys & cerebrum
- Below cerebrum

LIMBIC SYS

- located as an arc below Cerebrum
- Basic & primitive emotions & responses

CEREBRUM

* largest part

Ventral to thalamus

HYPOTHALAMUS

- Major chemical Coordinating centre
- Maintain Homeostasis
- Osmoreceptors
- Chemoreceptors
- Menstrual cycle

. Almond Shaped . lateral to thalamus

AMYGDALA

- Basic Emotions
- Pleasure, Punishment
- Fear, Rage, Love
- Sexual arousal

Horn shape Curved back to Amygdala

HIPPOCAMPUS

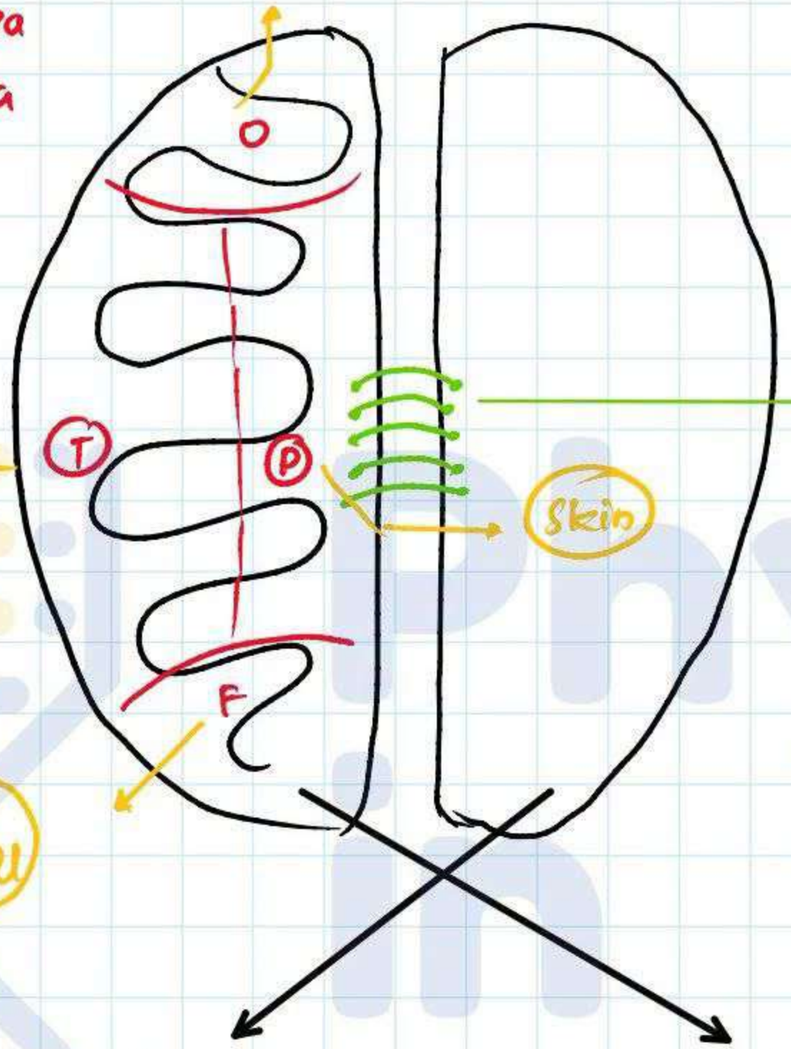
- Long term memory
- Learning

* Visual

- Sensory Area
- Motor Area

- Auditory & visual areas

Hearing / muscle



Surface area (Gyri, Sulci)

- Reasoning, Judgment, Dreaming
  Speech, Taste, Smell, Sight
  Learning (Short term memory)
  ↓
  IQ level

Corpus callosum
(Band of Axons)

Left Body

RIGHT Body

MID BRAIN → Reduced in Human
Relay Centre → Auditory
Reflex movement → Eye
Reticular formation
Screening of information

HIND BRAIN → IInd largest part

Small
lie above medulla

PONS

Involuntary Functions
Patterned involuntary
Pattern of Heart beat
Pattern of respiration
Transition b/w Sleep
& wake

- Brain stem
- Origin of Spinal Cord

MEDULLA OBLONGATA

Involuntary Functions
- Swallowing, Heart Rate
- Vomiting, Coughing
- Sneezing, Peristalsis

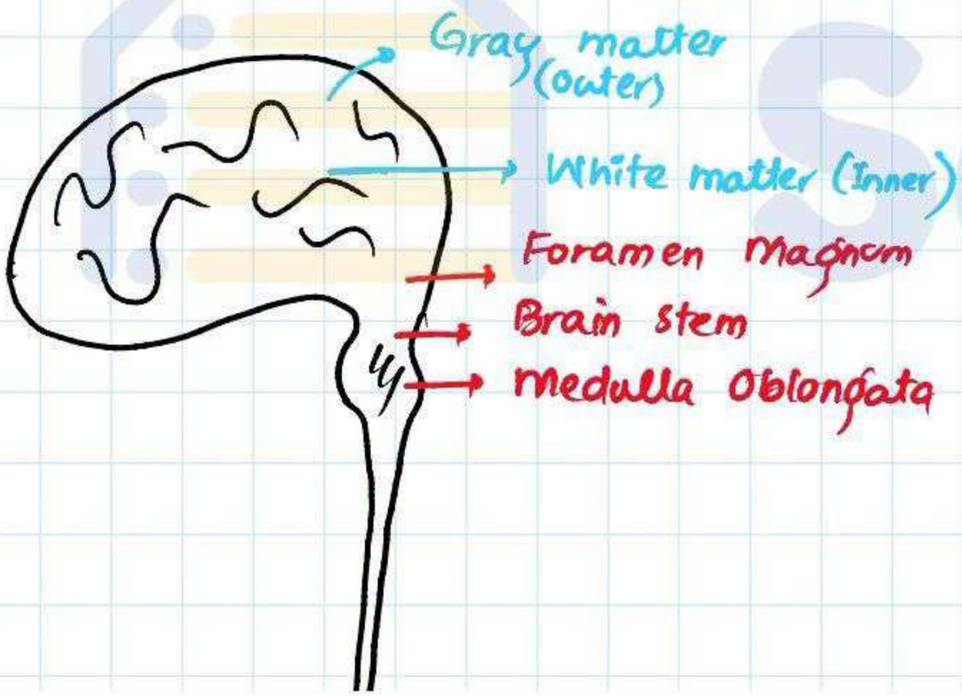
IInd brain
IInd largest part.

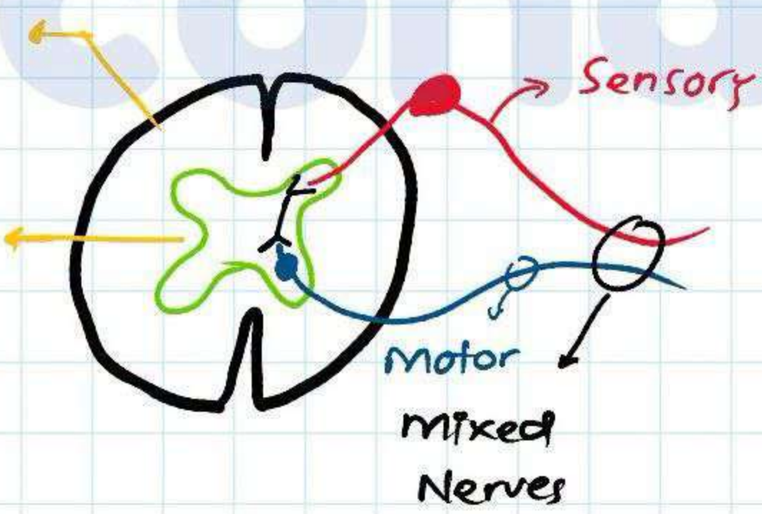
CEREBELLUM

- Body postures
- Equilibrium
- Gate,
- *. Behavior, Learning & memory

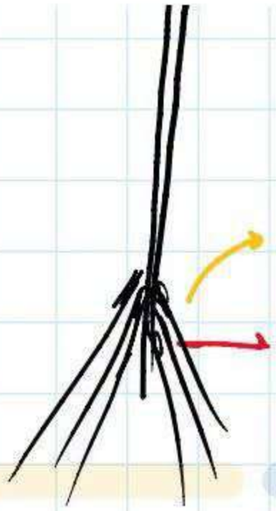
SPINAL CORD

- Foramen Magnum
- Originate from Brain stem
- link b/w Brain & body





Mixed
Nerves



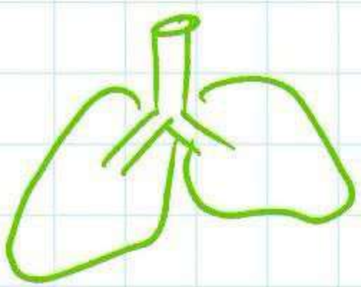
NERVES — 43 pairs (86 Nerves)

- 12 pair (24 Nerves) → **CRANIAL**
  - Sensory Nerves (I, II, VIII)
  - Motor Nerves (III, IV, VI, XI, XII)
  - Mixed Nerves (V, VII, IX, X)
- 31 pairs, 62 (Nerves) → **Spinal Nerves**
  - Mixed Nerves

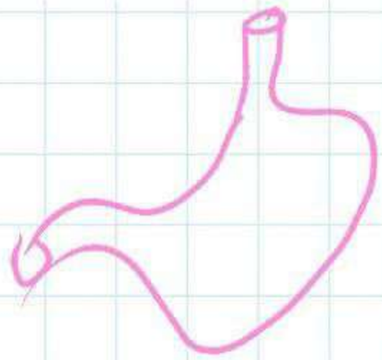
PNS

- **SOMATIC**
- **AUTONOMIC**
  - **SYMPATHETIC**
  - **PARASYMPATHETIC**

	Origin	
• Middle part of spinal cord		• Bottom part of spinal cord

· Middle part of spinal cord	Origin	· Bottom part of spinal cord
Near to S. Cord	Ganglia	Near to Effectors
Short	Pre-ganglionic Fiber	Long
Long	Post-ganglionic Fiber	Short
Emergency		Relaxed state
Dilate		Constrict
Inhibit (saliva)		Stimulate (saliva)
↑↑↑ Heart Rate		↓↓↓ Heart Rate
Relax airways		Constrict airways

inhibit activity



stimulate

→ NERVOUS DISORDERS

READING *

. PARKINSON'S DISEASE

. EPILEPSY

. ALZHEIMER'S DISEASE

CHEMICAL CO-ORDINATION → Blood → Cell ✓

Golgi App. ↑ → GLANDS → Secretory Ability ↑

A) Cell ↓ B) Group of cells ↓ C) Tissue / Organ ↓ D) All

A) Cell

- Goblet cell
- G-cell → Gastrin
- S-cell → Secretin

B) Group of cells

↓

Islets of langerhans
(Insulin, Glucagon)

C) Tissue / Organ

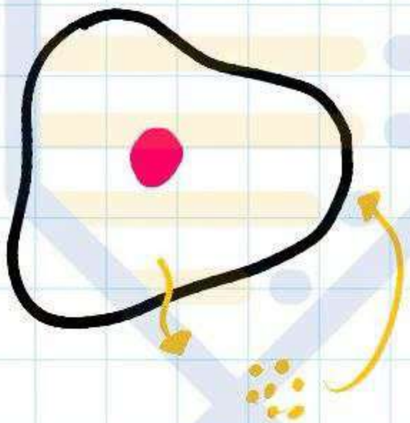
Adipose tissue

Liver
Pancrease

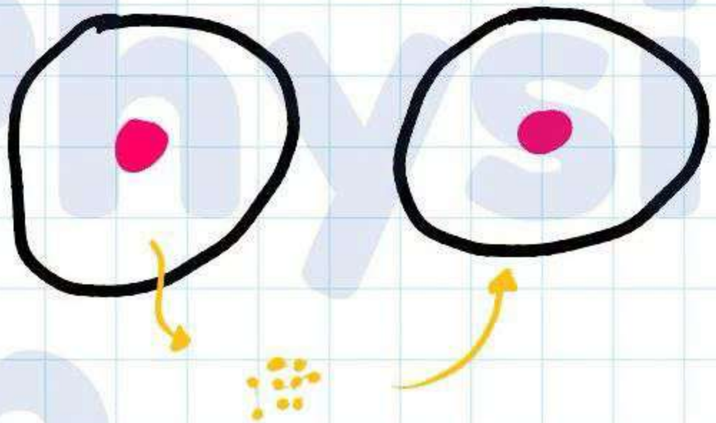
(D) All

→ Secretion

AUTOCRINE



PARACRINE



EXOCRINE ✓

Secrete over the Surface

Ducted glands

- Mostly Enzymatic
- Juices / special name

→ Saliva
→ Gastric Juice
→ Pancreatic Juice
→ Bile / Tear / Sweat / Ear Wax

ENDOCRINE ✓

Secrete in Blood

Ductless glands

- Hormones

↓

Organic Nature

. Greek word → Exciting

→ Bile | Tear | Sweat | Ear Wax

Greek word → Exciting (Setting in motion)

PROHORMONES (Inactive) → HORMONES* (Active) → Release

Release → Metabolite in Blood, Other Hormones, ANS*

ENDOCRINE SYSTEM OF MAN

→ 20 Endocrine glands

PINEAL GLAND

→ Smallest endocrine gland
→ Located in Brain
→ Melatonin

Sleep → Wake
↑↑ ↓↓

THYROID GLAND

→ Largest endocrine gland
→ Located in Neck
→ Thyroxin
↓
BMR**

CHEMICAL NATURE OF HORMONE

AMINO ACID ⇝ Tyrosine Amino Acid

↓
Receptor site inside

A T E N

Receptor site inside Nucleus

A T E N

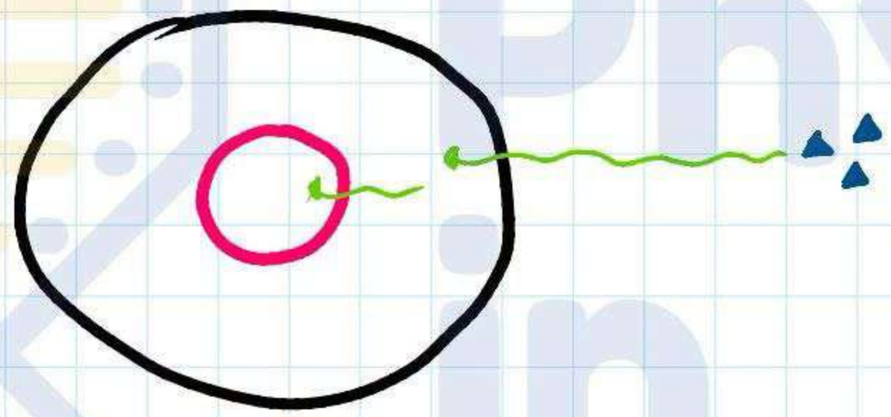
Thyroxin (T_3, T_4) → * Thyroid gland

Epinephrine (Adrenaline)

Nor-Epinephrine (Nor-adrenaline)

Catecholamines

* Adrenal - medulla.

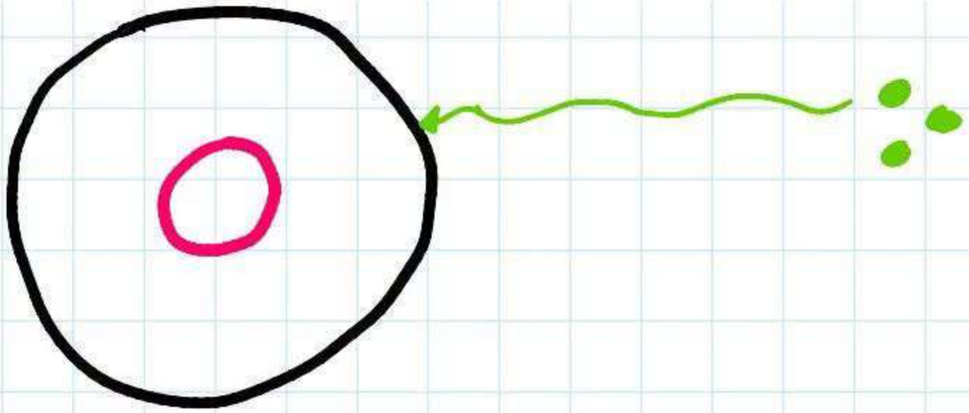


POLYPEPTIDE + Neuropeptides

P - A O

ADH

Oxytocin



PROTEIN → Receptors on Plasma Membrane.

- **P** — Insulin, Glucagon → Islets of Langerhans
- **I**
- **G**

STEROID *

- **S** → Testosterone → Testes
- **T**
- **O** → Oestrogen
- **C** → Cortisone → * Adrenal cortex

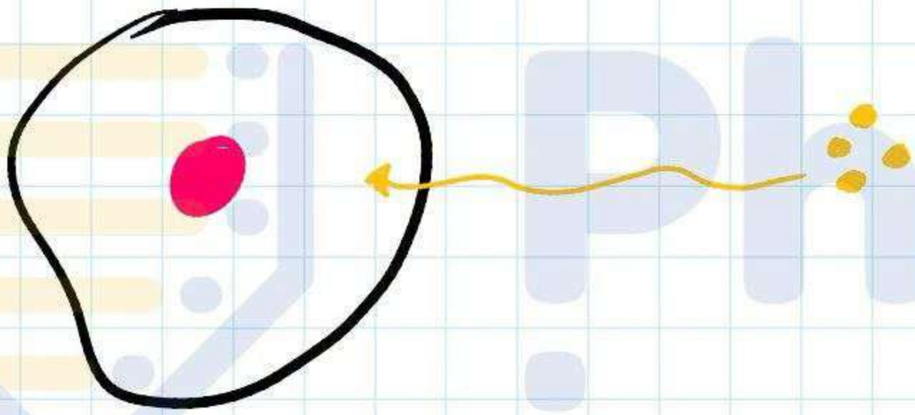
Testes

Oestrogen

Ovaries

Gonads

Adrenal cortex



→ Permeability of membrane
→ Intracellular Enzymes
→ Acting on Genes.

HYPOTHALAMUS → Chemical Co-ordinating Centre.

Master Control Centre

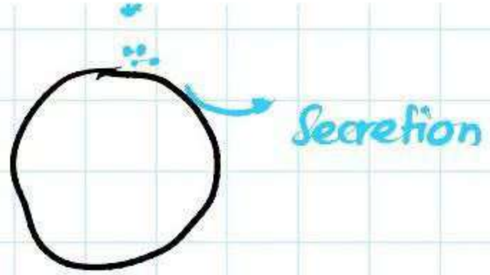
TROPIN / TROPHIN

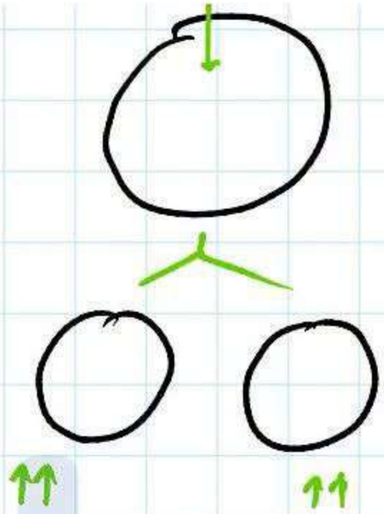
Factors

RF TF

TROPIC

TROPHIC





* FACTORS

GHRF ⟶ Secretion of (GH) ↑

Somatostatin ⟶ Inhibition of (GH)

TRF ⟶ (TSH) ↑

CRF ⟶ (ACTH) ↑

PIF ⟶ Inhibition of Prolactin

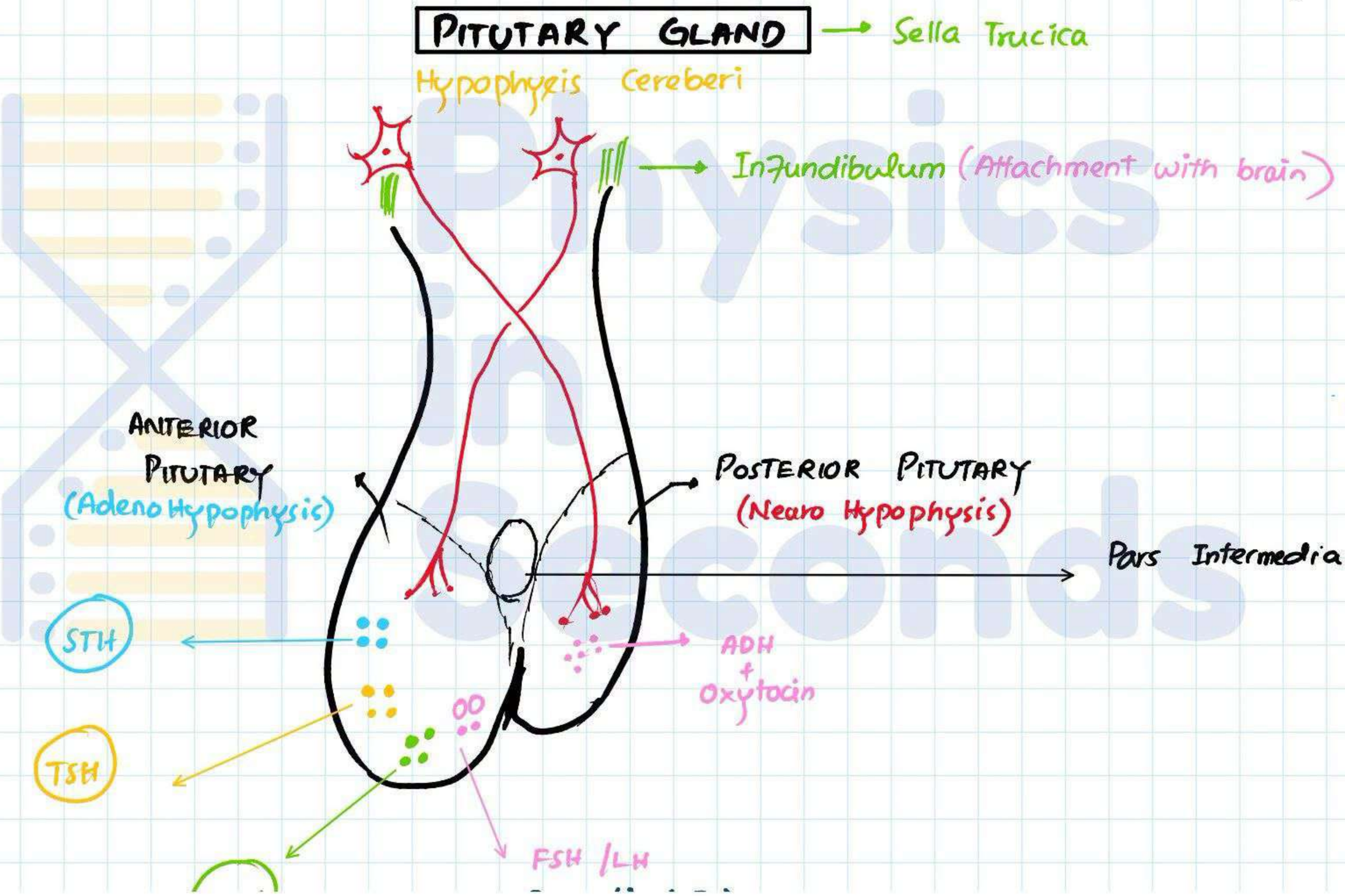
GnRH ⟶ FSH / LH (ICSH)

Neuropeptides

. ADH (Vassopressin) + OXYTOCIN ⟶ Produced from Hypothalamus

↓

Stored in Post. Pitutary



ACTH

FSH / LH
Prolactin (LTH)

Pitut. ← SRF

SOMATOTROPHIN HORMONE (STH) → Bones.

* Adrenal + Thyroid

Dwarfism

Gigantism

Acromegaly

↓↓ STH ↑↑

Birth ⟷ Adult ⟷ Death

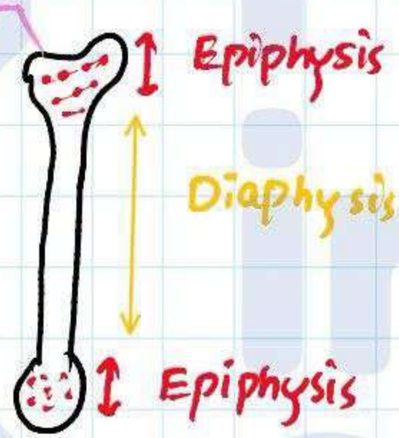
GROWTH PHASE

↓↓ STH ↑↑

* DECLINE PHASE

* Protein Synthesis cease

Growing Cells



THYROID STIMULATING HORMONE (TSH):

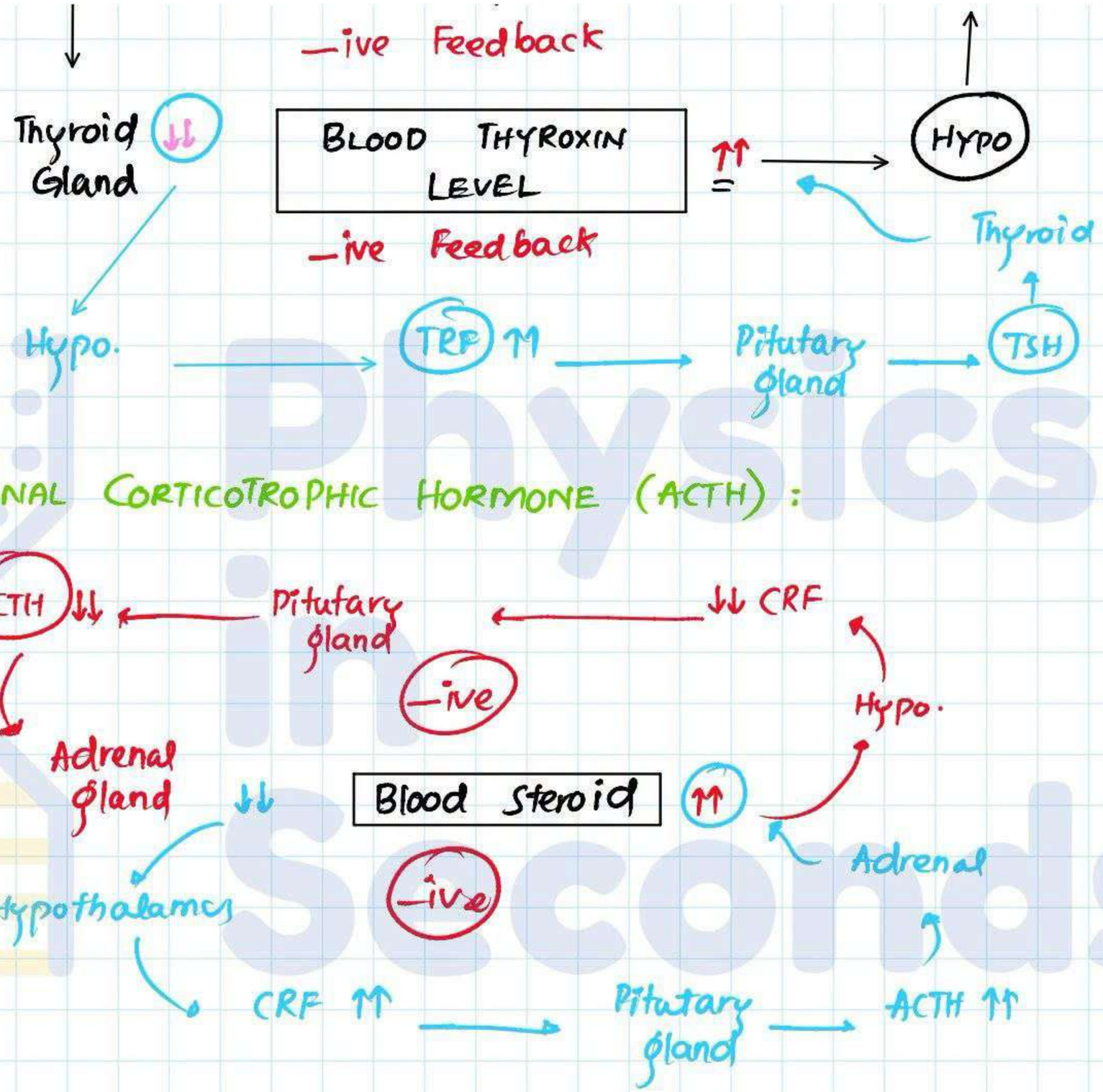
→ Secreted throughout life

→ Max. produced when rapid growth

Thyroid gland → Number ↑↑
Secretion ↑↑

TSH ↓↓ ← Pituitary gland ↓↓ ← TRF ↓↓

−ive Feedback


-ive Feedback
Thyroid Gland
↓↓
BLOOD THYROXIN LEVEL
↑↑ =
HYPO
Thyroid
-ive Feedback
Hypo.
TRF ↑↑
Pitutary gland
TSH
ADRENAL CORTICOTROPHIC HORMONE (ACTH) :
ACTH ↓↓
Pitutary gland
↓↓ CRF
-ive
Hypo.
Adrenal gland ↓↓
Blood Steroid
↑↑
Adrenal
-ive
Hypothalamus
CRF ↑↑
Pitutary gland
ACTH ↑↑
GONADOTROPHIC HORMONE (GH):
Common RF
PIH

Common RF

FSH / LH

PIH

Prolactin

. Stimulate milk production

FSH → * Gametogenesis

M → * Spermatogenesis

F → Follicles production

* FSH + LH → Estrogen + Ovulion

* Oogenesis

LH → F → Lutinization (Corpus luteum)

LH + LTH

↓

maintains Corpus luteum

ICSH → M → Testosterone

POST. PITUTARY → Neurohypophysis

ADH — Anti-Diuretic Hormone

Stimulus :

Blood Pressure ↓↓

Blood Volume ↓↓

Osmotic Pressure ↓↓

OXYTOCIN

Action Site → Smooth muscle.

* Stimulus:

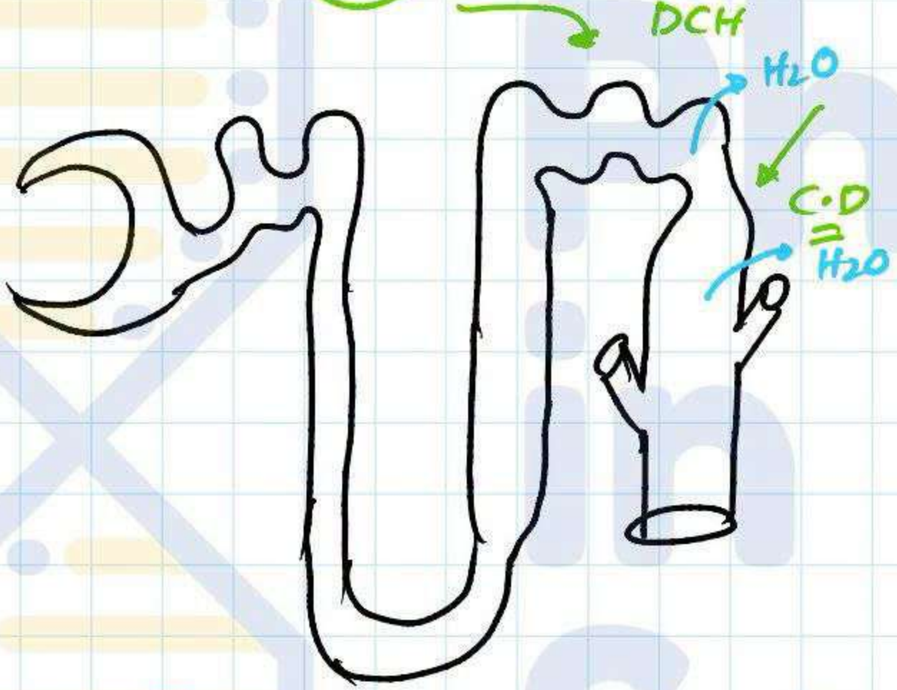
Distension of Cervix

Progesterone in Blood ↓↓

Neural Stimuli

Detected by Osmoreceptors of Hypothalamus

ADH ↑↑



- ADH ↓↓ (Diabetes Insipidus)
  - Urine ↑↑ (Polyuria)
  - Thirst ↑↑ (Polydepsia)

ME N PITUTARY :

Progesterone in Blood ↓↓

Neural Stimuli

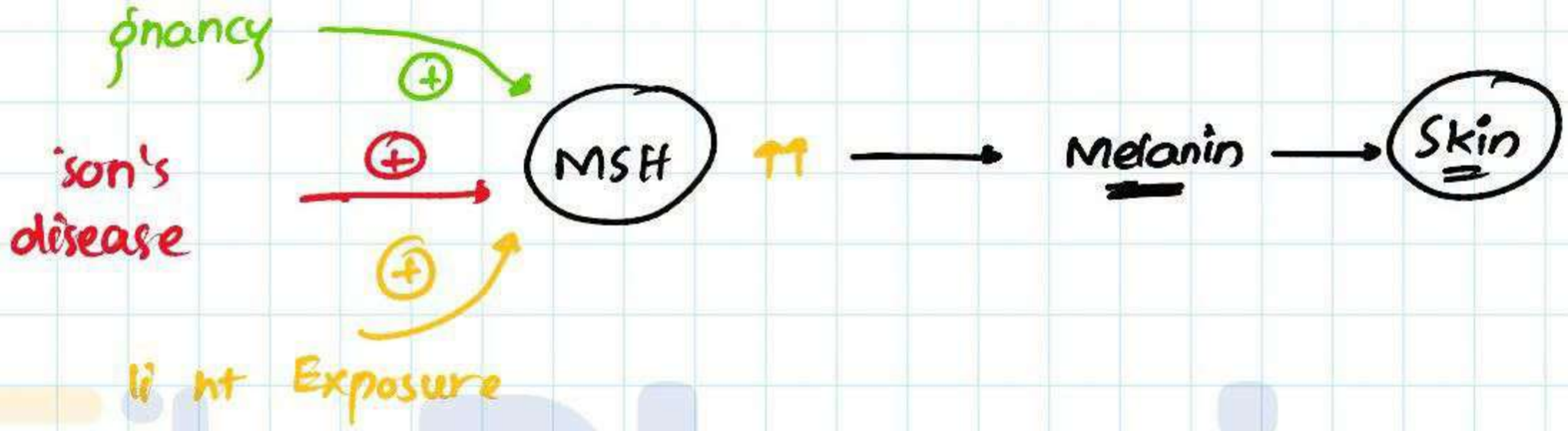
Suckling — Parturation

EFFECT :

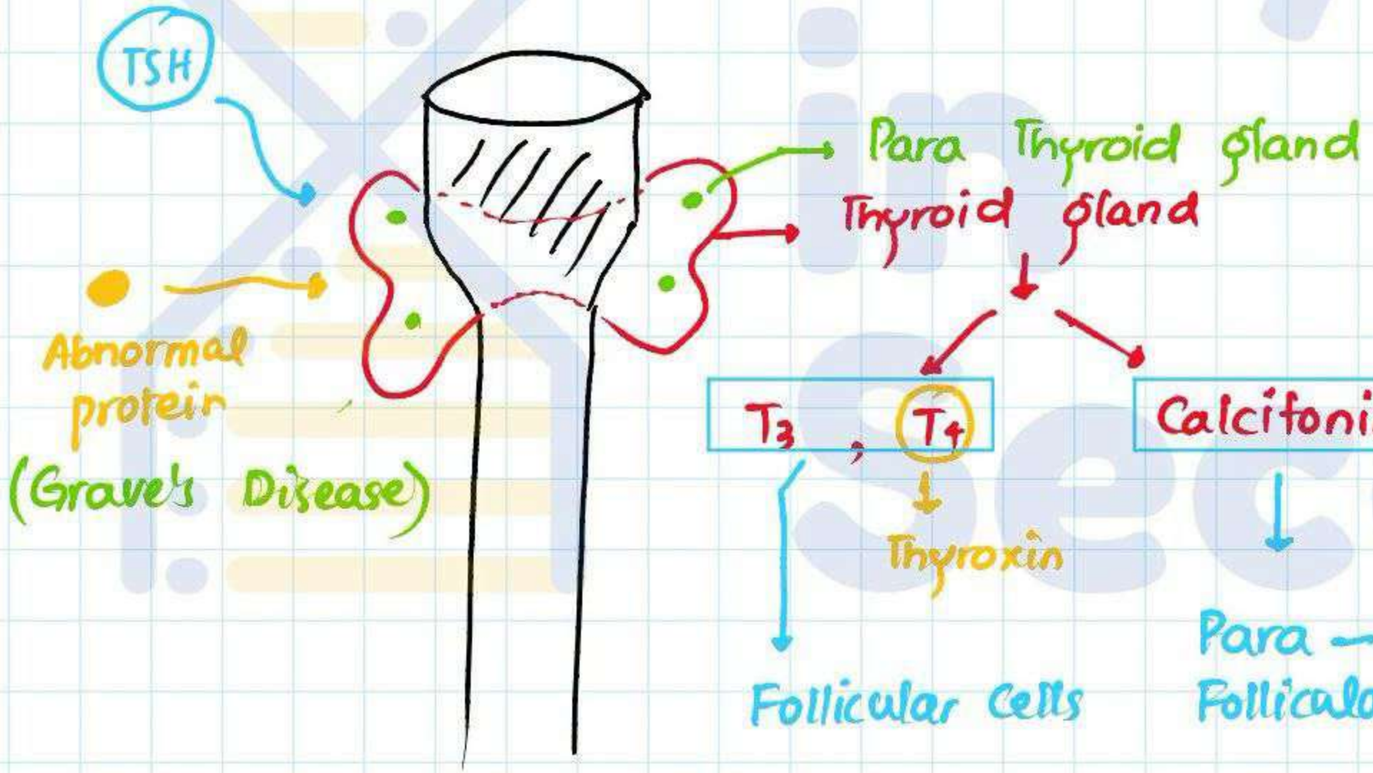
milk ejection ↑↑ — Child Birth

+ive Feedback

Pregnancy



THYROID GLAND → largest Endocrine gland



- Active Continuously
- Higher Secretions
  - → Rapid Growth
  - → Sexual maturation
  - → Stress Situation (Cold, Hunger)

(Hypothyroidism)
↓↓ ↓↓
Congenital (By Birth)

THYROXIN

Hyperthyroidism
↑↑↑↑ → Autoimmune.
Graves Disease

THYROXIN

↓↓ ↓↓
Congenitial (By Birth)
CRITINISM

↓↓ ×

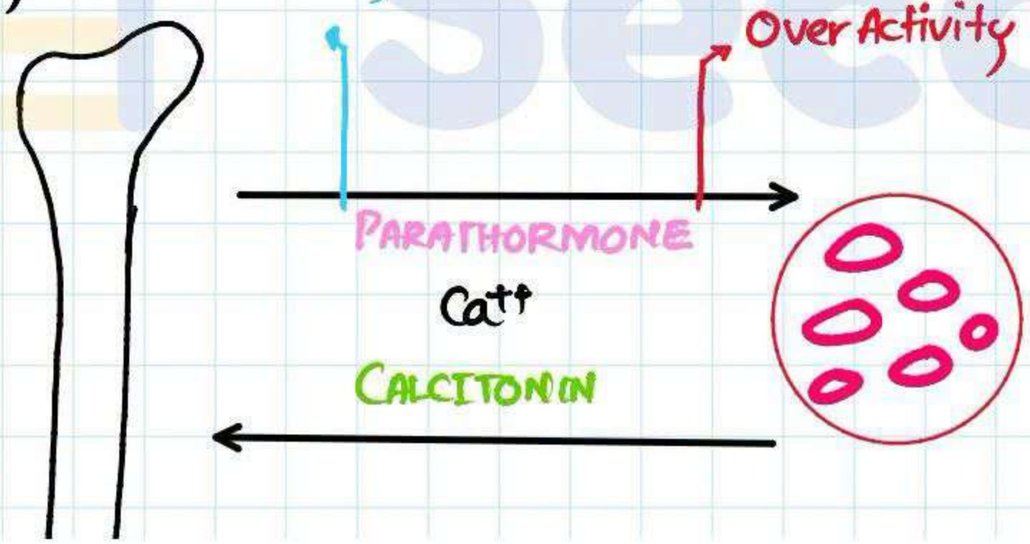
Scanty Hair, Small
Yellow Scaly Skin
Mentally retarded
Fails to develop sexually ×

ACQUIRED
→ MYXOEDEMA (Goiter)
. Puffiness of Hands
. Deposition of fats.

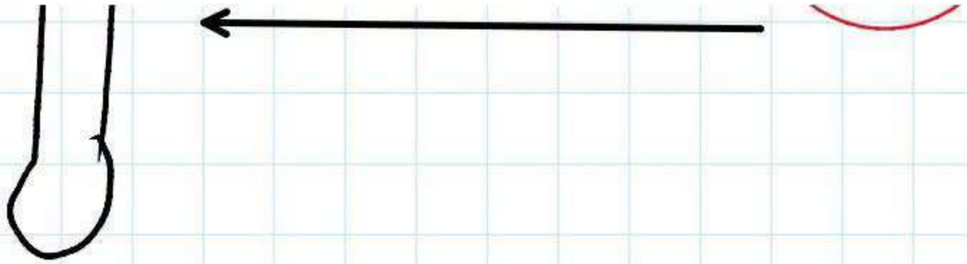
. BMR (Basal metabolic Rate) ↑↑
. metamorphosis
. Thyroxin + STH
(Growth + Brain cell Differentiation)
. Skeletal/muscleular

↑↑↑↑ → Autoimmune.
Grave's Disease
. Exophthalamic Goiter
* Cardiac Failure

. Muscular Tetany Under Activity



. Demineralization of Bones
. Massive Kidney Stones



PANCREAS → Dual gland
→ Heterocrine glands

Exocrine
↓
Acinar cells
(Pancreatic Juice)

Endocrine
↓
Islets of Langerhans
α - cells → Glucagon
β - cells → Insulin
δ - cells → Somatostatin

← STH
← ACTH
← Blood Glucose level

Hypoglycemia ↑↑
Hyperglycemia ↓↓

INSULIN ← β-cell Tumor

GLUCAGON → *Rare

↓↓	Blood Glucose level	↑↑
↑↑	Cellular uptake of Glucose	↓↓
↑↑	Cellular respiration of Glucose	↓↓
↑↑	Glucose → Glycogen	↓↓

↑↑ Glucose → Glycogen ↓↓
(Glyco-genesis)

Glycogen (Muscles + Liver)

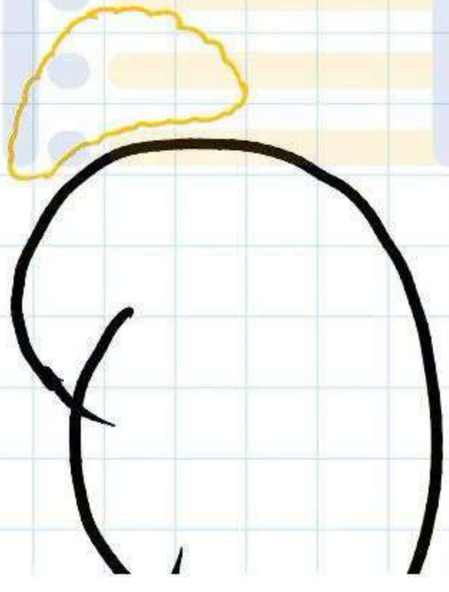
↓↓ Glycogen → Glucose ↑↑
+ (Glycogenolysis)
+ (Gluco-genesis)

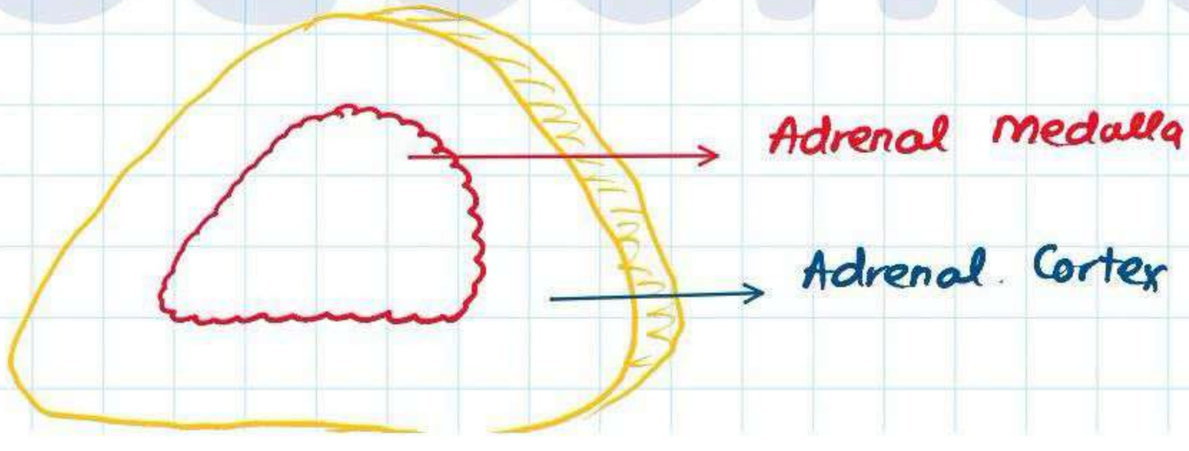
↓↓ Fat/Protein → Glucose ↑↑
+ (Gluco-neo-genesis)

DIABETES MELLITUS:

- Low insulin production → Blood Glucose ↑↑
  (Glycosuria) → Urine glucose ↑↑

ADRENAL GLAND → Supra-renal gland
→ Emergency glands





- Cold, Stress

- Hypertensive
- Aggressive

Under Secretion ↓↓

↑↑ Excess Secretion

ADRENAL MEDULLA

Adrenaline → Epinephrine → Vasodilators

Synergistically Function

Nor-adrenaline → Nor-Epinephrine → Vaso-constrictor

Prepare For Emergency Condition

Cardiac Output ↑↑
Gut supply ↓↓
Release of Glucose ↑↑

ADRENAL CORTEX

Addison's Disease ↓↓

↑↑ → Cushing's Disease (Moon Faced)

↓

Corticoid (Shock, Stress, Infection)

GLUCO-CORTICOID → **CORTISOL**

- Increase blood glucose level

GLUCO - MINERALO → **CORTICOSTERONE**

- Glucose level ↑↑
- Mineral ions ↑↑

MINERALO-CORTICOID → **ALDOSTERONE**

- Conserve Na^+ level
- Loop of Henle

ANDROGENS → Testosterone

- Secondary male characters
- Female body → Adrenal tumor → Secondary Hair Growth

GONADS → Endocrine Sex Glands

TESTES

- Testosterone
- 17 β-Hydroxy Testosterone
  - Sex organs in Foetus
  - LH (ICSH) → Testosterone

PCOD ↑↑

OVARIES

- **OESTROGEN** ↓↓
  - From Ripening Follicles
  - Sexual character
- **PROGESTERONE**
  - Thickening & vascularization of wall

. Sex organs in Foetus
. LH (ICSH) → Testosterone
. Male Secondary Characters
. Sex derive ↑↑

Follicles
. Sexual characters
→ Thickening of uterine wall
→ (+ive) → (LH)
→ Healing & reparing of wall.
→ Protein secretion during early age

vascularization of wall
. Maintains pregnancy
. Ovulation ↓↓ (Birth Control) pills