* Acid - Base Balance —

→ Very important for homostasis and all Physiological activities

- acid :- Proton donor
- Base :- Proton acceptor
- acidosis :- Process that adds acids (low Plasma pH)
- alkalosis :- Process that adds base (high plasma pH)

• Acid - Base Status —

→ Hendesson - Hasselbalch Equation

use:- finds the pH of a weak acid from its acid

- weak acid :- $PH = PKa + \log \frac{\text{conjugate base}}{\text{weak acid}}$
- weak base :- $POH = PKb + \log \frac{\text{conjugate acid}}{\text{weak base}}$

- Normal acid - base ratio :- 1:20 ($CO_2 : HCO_3^-$)

* Regulation of Acid - base balance —

→ 2 types of acids are produced in body -

1. Volatile acids	2. Non - Volatile acids (fixed acids)
→ Derived from CO_2	→ Derived from Protenis.
→ Large qulity of CO_2 Produced during metabolism of carbohydrates and lipids	→ Real theat to acid - base Status of body
→ Lungs	→ Kidneys

0 — 7 — 14

(Acidemia) (7.35 - 7.45) (alkalemia)

(Acidic) (Neutral) (alkaline)

* $pH = \log \frac{1}{[H^+]}$ • Normal PH :- 7.35 - 7.45

* Compensatory mechanism
→ 3 different mechanism to PH back normal level.
1. acid - base buffer System
2. Respiratory mechanism
3. Renal mechanism.

1. acid - base buffer System
→ which bins free H^+
→ Is faster one it acidJusts the PH within Seconds.
→ combination of weak acid and base
→ TYPes :- 1. Bicarbonate buffer System
2. PhosPhate buffer System
3. Protein buffer System.

i. Bicarbonate buffer System (BBS)
- Present in ECF (Plasma)
- Bicarbonate buffer System is not Powerful like the other buffer System because the large difference b/w PH of ECF and PK of BBS.
- under acidic condition → combines with H^+
- under alkaline condition → Releases a H^+
- concentration of HCO_3^- regulated by Kidney
- concentration of CO_2 regulated by Lungs.
- $HCl + NaHCO_3 \longrightarrow H_2CO_3 + NaCl \longrightarrow CO_2 + H_2O$

ii) PhosPhate buffer System
- Present in ICF (cytoplasm) and renal tubules
- components :- HPO_4^{-2} (weak acid), $H_2PO_4^-$ (weak acid)
- concentration of Phosphate ICF > ECF
- $HCl + Na_2HPO_4 \longrightarrow NaH_2PO_4 + NaCl$
- $NaOH + Na_2HPO_4 \longrightarrow Na_2HPO_4 + H_2O$

- useful in tubular fluids of kidney. Because more Phosphate ions are present in tubular fluid.

iii) Protein Buffer system

- Present in blood ; both in plasma and electrolytes
- • In Plasma
  - weak acid c-terminal carboxy group [weak]
  - N-terminal amino group
  - Side chain carboxyl group of glutamic acid
  - Side chain amino group of lysine
- • In erythrocytes (Hb)
  - Hb is the most effective protein buffer and the major buffer in blood.
  - The deoxygenated Hb is a more Powerful buffer than oxygenated Hb because PK is higher

2. Respiratory mechanism (Removal CO_2)

- lungs are the primary regulator for respiratory imbalances.
- CO_2 is the primary gas
- H^+ ions always go in the same direction as CO_2 That means CO_2 increase $\longrightarrow$ H^+ increase
- more CO_2 in body, H_2O is bind to CO_2 and react H_2CO_3

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

(more in Body)

3. Renal Mechanism:-
Present in kidney.
Kidney control acid-base balance by excreting either acidic or basic urine.
- To Acidosis condition
  - Retains = bicarbonate , eliminates = H^+
- To Alkalosis condition
  - Retains = H^+ , eliminates = bicarbonate
Being the body's most effective regulator of blood pH.

* Disturbances of acid-base status:-

- acidosis :- reduction in pH below normal range
1. Increase PCO_2 in arterial blood
2. Decrease HCO_3 concentration.

- alkalosis :- increase in pH , above normal range
1. Decrease PCO_2 in arterial blood
2. Increase HCO_3 concentration.

→ 2 types of disturbances
1. Respiratory disturbances :- Change in arterial PCO_2 , controlled by lungs.
2. Metabolic disturbances :- Change in HCO_3 concentration.

$P_{CO_2} \propto T$

- Acid - base disorders.

	Disorder	PH	H^+	Primary disturbance	Secondary response
1.	Metabolic acidosis	↓	↑	↓ $[HCO_3^-]$	↓ P_{CO_2}
2.	Metabolic alkalosis	↑	↓	↑ $[HCO_3^-]$	↑ P_{CO_2}
3.	Respiratory acidosis	↓	↑	↑ P_{CO_2}	↑ $[HCO_3^-]$
4.	Respiratory alkalosis	↑	↓	↓ P_{CO_2}	↓ $[HCO_3^-]$

- causes of acidosis -

Metabolic acidosis

- ~~Airway obstruction~~
- Lactic acidosis in circulatory shock
- Ketoacidosis in diabetes mellitus
- uric acidosis in renal feilure

Respiratory acidosis -

- Airway obstruction bronchitis, emphysema.
- Lungs diseases like fibrosis.
- Respiratory center depression

- lactic acid :- increases in anaerobic glycolysis
- Keto acidosis :- increases in insulin deficiency
- uric acid :- increases to feilure excretion

• cause of alkalosis

Metabolic alkalosis	Respiratory alkalosis
- vomiting, diarrhea.	- Hypoxia in high altitude
- endocrine disorders	- chronic anemia
	- Psychological and emotional trauma.

* Variations in anion gap-

Increase in anion gap	Decrease in anion gap
- Metabolic disorder	- Hyperchloremic acidosis
- Dehydration	- Hypoalbuminemia
- renal disease	- renal disease
(PO_4^{-3}) (SO_4^{-2})	(Na) (K)
- Nutritional deficiencies	- Toxicity due to Li and Br

• clinical evaluation of disturbances in ab status

- only few anions & cations are measured during routine clinical investigations.
- Measured cation :- Na^+
  Measured anion :- Cl^- & HCO_3^-
- unmeasured ~~cation~~ anion :- PO_4^{-3} (Phosphate), SO_4^{-2}
  unmeasured ~~anion~~ cation :- K^+, Ca^+ & Mg^+
- difference b/w concentrations of unmeasured anions and unmeasured cations is called anion gap it is 12 mEq/L & (9-15 mEq/L)

* Cell Physiology —

- Smallest functional unit of the body
- cells are a link between Molecules and Human
- Micro Molecules → organells → cell → Tissues → Body organs → Body systems → Body.

* General characteristics of cell —
→ Needs Nutrition & O_2
→ Produces its own Energy for its growth, repair and other activities
→ Eliminates CO_2 and other metabolic wastes.
→ Reproduces by division.

* tissue —
→ group of the cells.

1) Muscle tissue
   i) Skeletal tissue
   ii) Smooth
   iii) cardiac

2) Nervous tissue
   i) Neurons
   ii) Supporting cell

3) Epithelial tissue.
   i) Squamous
   ii) columnar
   iii) cuboidal

4) connective tissue
   i) connective tissue proper
   ii) cartilage
   iii) Bone
   iv) blood.

* Body System

1) Digestive System
2) Nervous System
3) Reproductive System
4) Cardiovascular System
5) Excretory System
6) Endocrine System
7) Musculo System
8) Respiratory System

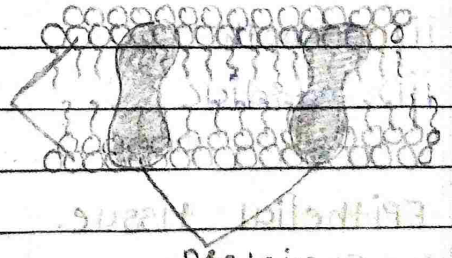
Cell

Subdivision.

1. Plasma membrane 2) Nucleus 3) Cytoplasm

1. Plasma membrane / cell membrane.

→ Also called as Plasmalemma.
→ Separates to outside fluid of cell and Intracellular fluid.
→ Semipermeable membrane.
→ Thickness :- 7.5 to 10 nm.
→ Present a 2 layers of Phospholipids with Protein and sugars molecule.
→ central layers → lipid
→ Two layers → Protein

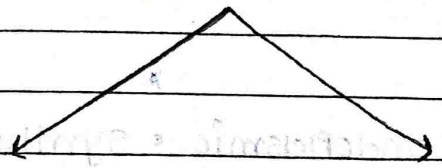


• cell Membrane

• Proteins (55%.) • Lipids (40%.) carbohydrates (5%.)

2. Nucleus.

→ Largest cellular organelle.
→ occupiest about 10 % of total volum of cell.
→ Every cell has Nucleus [except Matured RBC]
→ Shape :- oval & Spherical
→ Surrounded by a double layered membrane.
→ Nuc.



• eukaryotes
→ with Nucleus

• Prokaryotes.
→ with out Nucleus.

• functions.
→ control of all activites of the cell.
→ Synthesis of RNA :-
→ control cell divison
→ Storage hereditary information in genes (DNA)
→ formation of ribosomes
→ monitoring Protein Synthesis. and help to sending information.

3. Cytoplasm.

→ it is Jellylike material formed by 80 % of water.
• Cytosol :- contaiint clear liquid.
• Cytoplasmic Organelles.
1) with limiting membrane
1) ER
2) golgi apparatus
3) Lysosomes
4) Peroxisome
5) centrosome & centrioles
6) secretory vesicles
7) Mitochondria
8) Nucleus

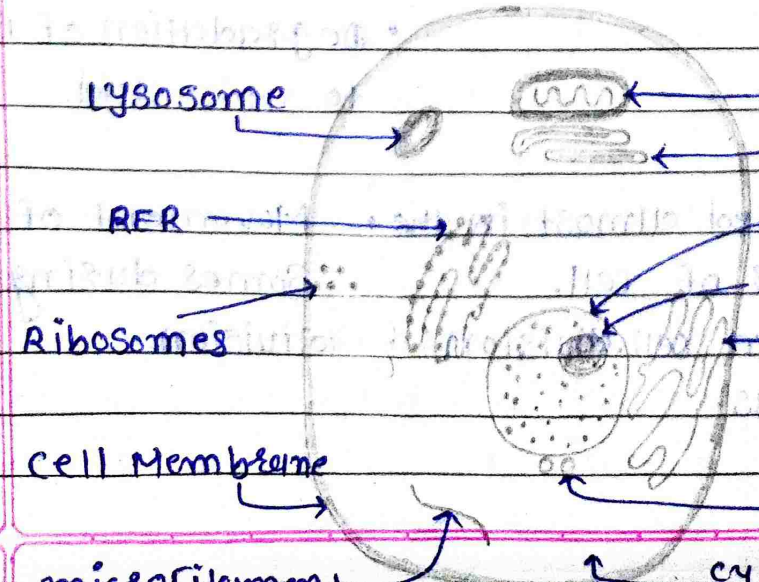
2) with out limiting membrane.
1) Ribosomes
2) cytoskeleton.

* cytoplasmic organelles.

	Name	introduction	functions
1.	ER		*
	i) SER	• Smooth endoplasmic Reticulum • more present in liver • detoxification	• synthesises lipids and steroids • Role in cellular metabolism • Storage & metabolism of calcium • catabolism and detoxification of toxic substance
	ii) RER	• Rough endoplasmic Reticulum. • Ribosomes on its surface.	• synthesises of proteins • Degradation of worn-out organelles.
2.	Golgi Apparatus	• membrane - bound Organelle • Present the all cell [except RBC cell] • [redacted] • existence :- - flattened membranous sacs - 5 to 8 per cell.	• Post office of the cell • Processing, labeling and delivery of Proteins and lipids

3.	Lysosomes	• garbage system • formed by golgi appa... • 50 hydrolytic enzymes present in lysosomes.	• degradation of macromolecules • degradation of worn-out organelles. • secretion of melanin and serotonin
✱.		• Important lysosomal enzymes. 1) Proteases :- Proteins ⟶ Aamino Acid 2) lipases :- lipids hydrolyze ⟶ fatty Acid & glycerides 3) Amylases :- Polysaccharides ⟶ glucose 4) Nuclease :- Nucleic acid ⟶ Mononucleotides	
4)	Peroxisomes	• unlike lysosomes • Pinched off from ER. not from golgi APPa...	• Breackdown more fatty acids. • detoxification H_2O_2 & other metabolic Products. • Acceleration of gluconeo-genesis. • Role in the formation of myelin and bile acids. • O_2 utilization • Degradation of Purine to uric acid.
5)	Centrioles	• situated almost in the center of cell. • help in cell division Process.	• Movement of chromo-Somes during cell division.

6)	Mitochondria	• Production of energy • covered by a bilayered membrane. • oval shaped • diameter :- 0.5 to 1 μ.	• ATP synthesis • energy production • Storage of Ca. • detoxification of Ammonia in liver.
7)	Nucleus.	⊛ As follows	
8)	Ribosomes	• Read messenger RNA and translate the genetic code into Amino Acids from Proteins.	• bind to mRNA • Read mRNA sequence • responsible for protein synthesis.
9)	Cytoskeleton	• Network of proteins	• gives structure to cell. • cell movement • Transport • cell division



* Transport through cell membrane -

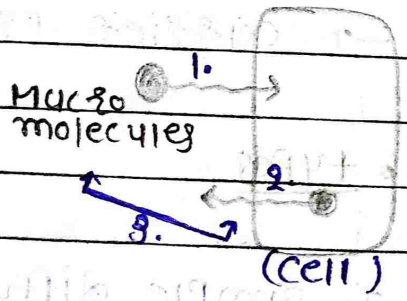
→ The cell membrane is one of the great multitaskers.
→ it is can also called gatekeeper
→ Phospholipid bilayer determines what molecules can move into or out of the cell.

Active Transport	Passive Transport
→ movement of molecules against the concentration gradient. (low to high)	→ movement of molecules through the concentration gradient. (high to low)
→ movement of large molecules	→ movement of small and water molecules.
→ It requires energy	→ It does not requires energy.
→ Rapid movement	→ Slow movement
→ requires carries protein	→ carries protein not involve
• types	• types
1. Primary active tra.	1. Simple diffusion
2. Secondary active tra.	2. facilitated diffusion
	~~i) Co - transport~~
	~~ii) counter transport~~
• carries protein —	• Gated Channels.
	i) voltage gated Channels
1. uniport Pump	ii) Ligand gated Channels
2. Symport / antiport Pump	iii) Mechanically gated Channels
• Special types —	• Special types —
i) endocytosis	i) Bulk - flow
ii) exocytosis	ii) filtration
iii) Transcytosis.	iii) osmosis
	i) endosmosis ii) exosmosis

• Active transport — (energy use)

Primary active tra.	Secondary active tra.
→ energy is liberated directly from breakdown of ATP.	→ energy is liberated Indirectly from Stored ionic —
→ Substances like Na, K, Ca, H, Cl are transported.	→ Transport of a Substance with Na ion, by means of common carrier protein 1. Co - transport 2. counter transport

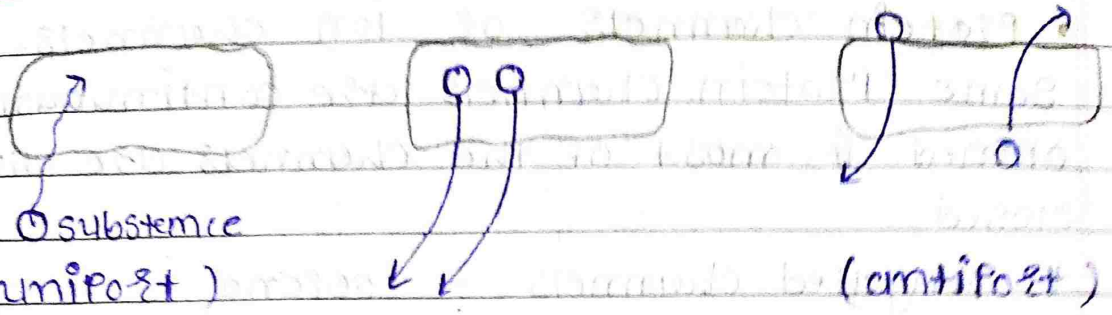
• Special types of active transport —



1. endocytosis - macro molecule enter the cell
2. exocytosis - macro molecule out the cell
3. Transcytosis - macro mole. enter through one side of the cell & exits through other side.

• Carrier Proteins —

1. uniport Pump	2. Symport / antiport Pump
→ Protein that carries only one Substance in a single direction	→ Protein that transports to two different substance in the Same direction ↳ Symport opposite direction



← • carries Proteins • →

• Passive transport —

1. simple diffusion	2. facilitated diffusion
→ Directly across the membrane.	→ Requires some carrier protein
ex. O_2 , CO_2	→ carrier - mediated transport
→ occurs through the phospholipid bilayer	ex. glucose & amino acids
	→ occurs through the transmembrane Proteins
	→ faster than simple diff..

• special types of Passive transport

1. Bulk flow :- large quntity of substemce from region high Pressure to low Pressure.
ex. exchange O_2 & CO_2 in lungs.

2. filtration :- movement of water & solutes from high hydrostatic Pressure to low hydrostatic Pressure.

3. osmosis :- movement of water & any solvent from low concentration to higher concentration

• Protein channels or ion channels-

→ Some protein channels are continuously opened & most of the channels are always closed.

1. ungated channels - opend
2. gated channels - closed
   - These channels are opened only required condi-

• Gated Channels :-

1. Voltage - gated channels -
   - activated by changes in the electrical potential difference across the cell membrane

2. Ligand - gated channels :
   - activated by the binding of specific chemical messengers called ligands - eg. [hormone / substance]

3. Mechanically - gated channels-
   - activated by come to some mechanical factors

• factors affecting rate of diffusion

1. Permeability of the cell membrane
2. Temperature
3. Solubility of substance
4. Size of ions
5. Thickness of membrane
6. Charges of the ions

01/01 Monday / Wk-01/Day (001-364)

HOMEOSTASIS

→ Maintenance of Constant internal Environment of body

Homeo = Same
Stasis = Standing

→ Word 'Homeostasis' is introduced by Walter B Canon in 1930

ECF - Extra Cellular fluid
- fluid outside the cell
- Constantly moves throughout the body

ICF - Intra cellular fluid
- fluid Contained within all body cells

→ ECF Contains plasma & Interstial fluid

Phone/Email/Notes

Notes → Role of Various systems in homeostasis

1) Digestive system - provides essential nutrients like amino

DECEMBER

M		4	11	18	25	
T		5	12	19	26	
W		6	13	20	27	
T		7	14	21	28	
F	1	8	15	22	29	
S	2	9	16	23	30	
S	3	10	17	24	31	

-acids, carbohydrates and amino acids for various activities of the cells.

2) Respiratory system - responsible for water balance, acid-balance and temperature of body
- supplies oxigen to cell for metabolism

3) Excretory system - responsible for water balance electrolyte balance, acid-base balance & osmolality of body fluids

4) SKIN - { also helps in excretion by removing urea & sweat

5) circulatory system - responsible for flow of blood which contains nutrients, metabolic waste.

6) Lymphatic system - responsible for redistribution of fluid in body.

7) Endocrine system - secreates hormons which are essential for metabolism

8) Skeletal muscle - preventing damage/destruction

9) Newous systems - includes brain & spinalcord
→ which regulates all systems.

01 / 03 / Wednesday / Wk-01/Day (003-362)

→ Components of Homestatic System

i) Sensor / Detectors / Receptors

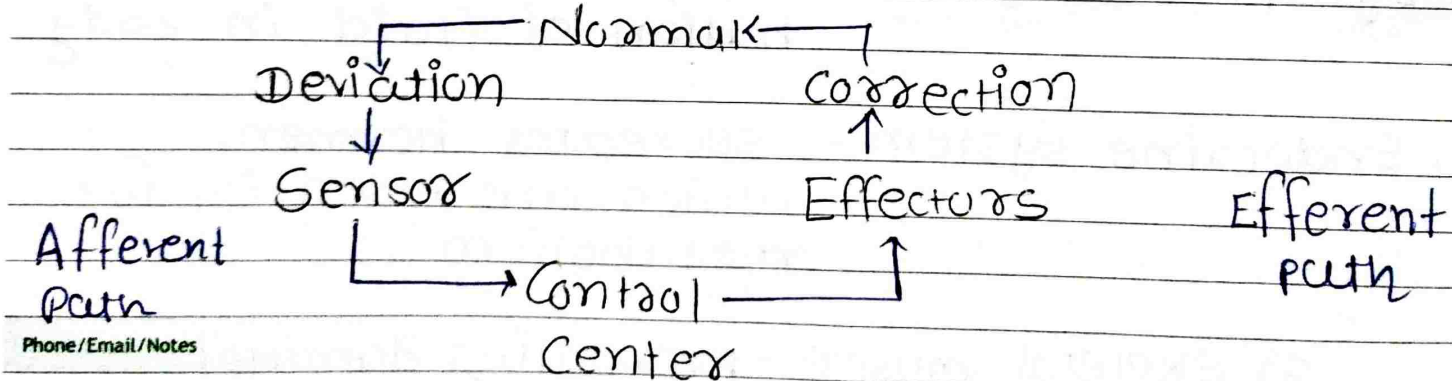
- recognize the deviation in any activity in internal environment
- transmit message to control centre

ii) Control centre / Integrator centre

- receives the message from receptors
- immediatley sends Commands to Concerned effectors

iii) Effectors

- receives commands from center
- either accelerate or inhibit activity



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Notes

DECEMBER

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2018

Wk-01/Day (004-361) / Thursday 04/01

→ Mechanism of Action of Homeostatic Systems

→ Feed back signals / Control system

2 Types - POSITIVE AND NAGATIVE

1] POSITIVE FEED BACK

- increase intensity of the change in same direction
- less common than negative feed back
- its own significance during emergency conditions

exa:- blood clotting, Milk ejection reflex & parturition

~~Injury~~ injury to blood vessel

↓

Formation of prothrombin activator stage.1

↓

Conversion of prothrombin into thrombin stage.2

↓

Conversion of fibrinogen into fibrin stage.3.

↑

stopage of bleeding

Phone/Email/Notes

Notes

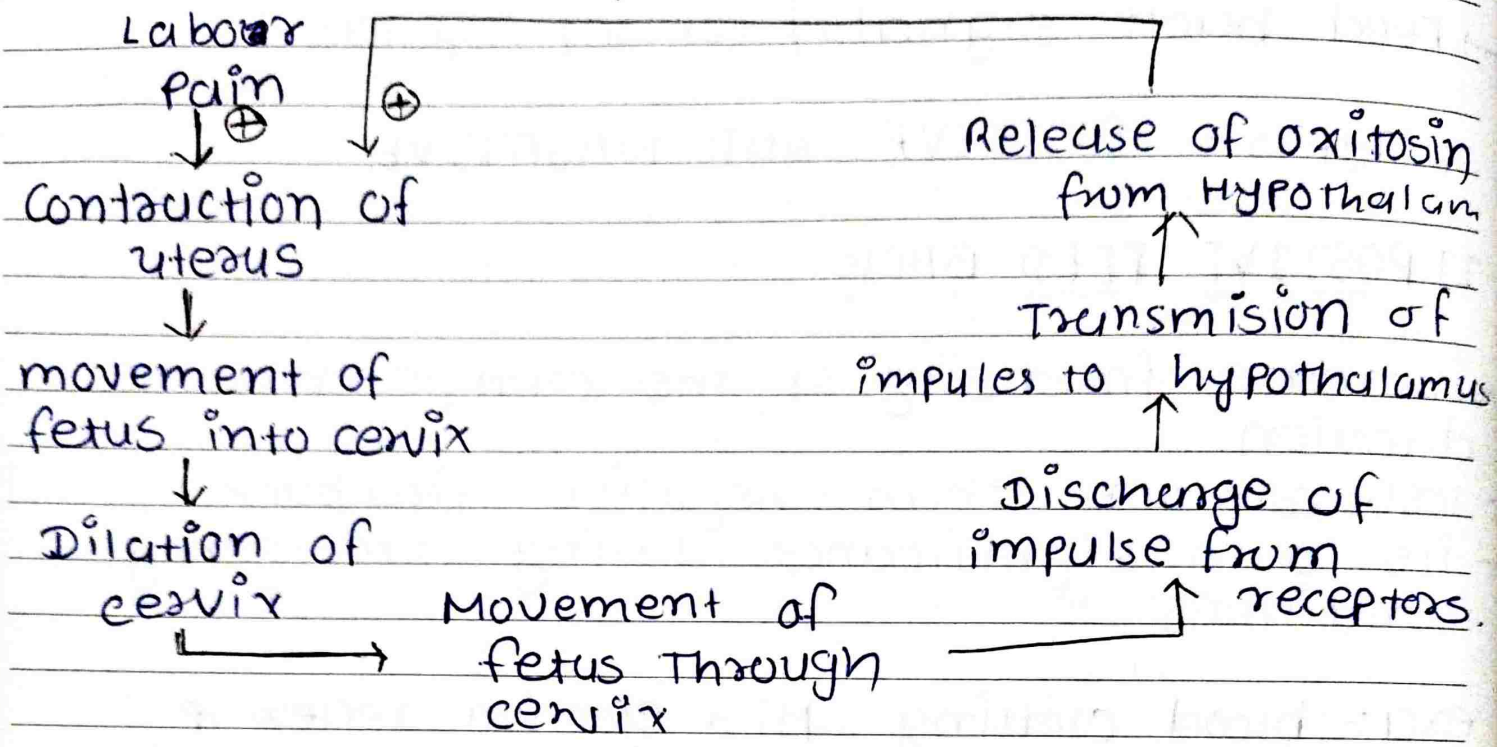
JANUARY

M	1	8	15	22	29	
T	2	9	16	23	30	
W	3	10	17	24	31	
T	4	11	18	25		
F	5	12	19	26		
S	6	13	20	27		
S	7	14	21	28		

01 / 05 / Friday / Wk-01/Day (005-360)

Feed-Forward Mechanism

exa. 2.]



2] NAGATIVE FEEDBACK

→ arrest the change / reverse the direction of change

→ Many system are regulated by N.F.

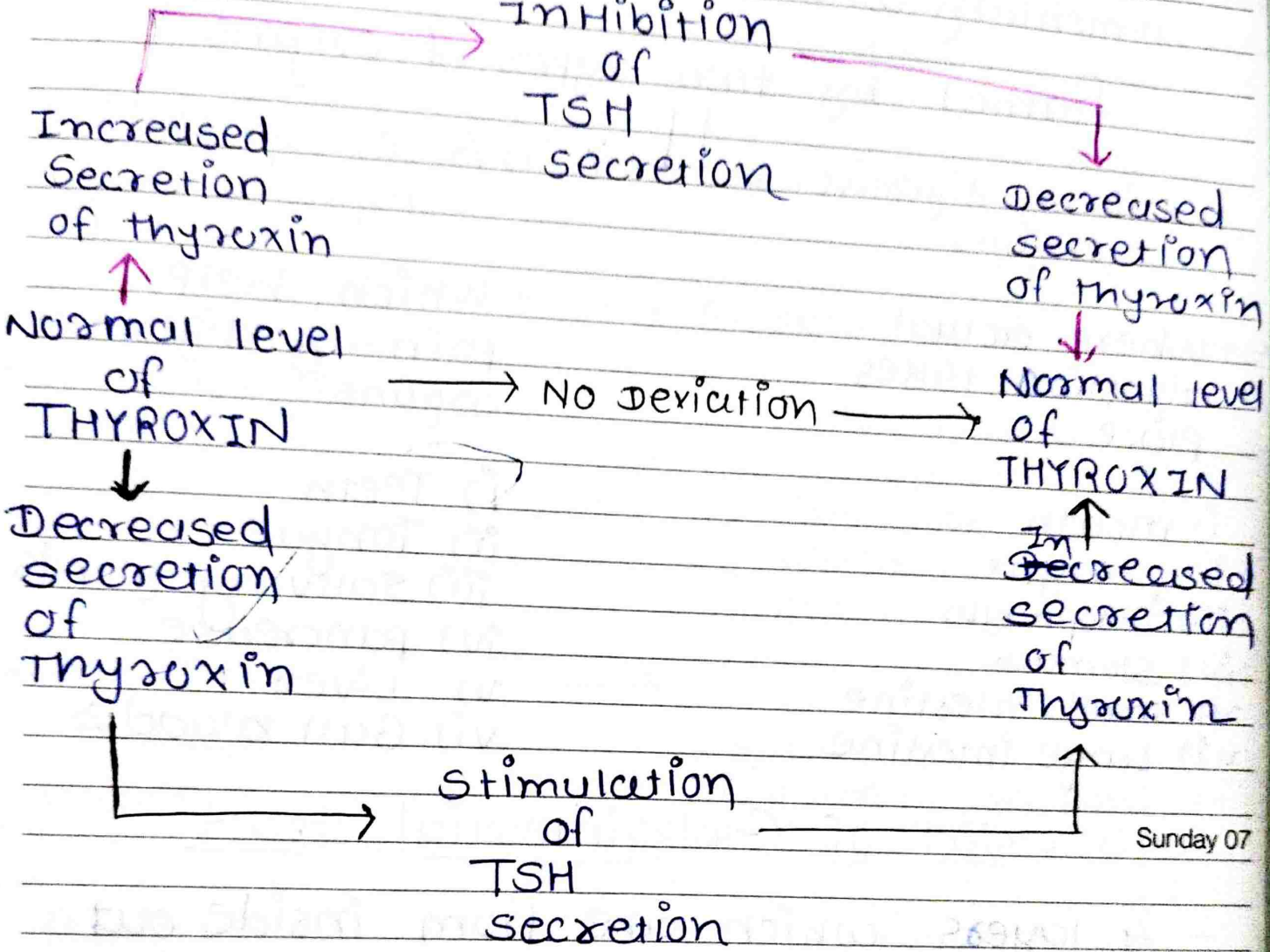
→ exa:- Secretion of thyroxin
- Maintenance of water balance,

* In Negative feedback
- More frequent
- closely asociated with stability
- Resists change
- Narrower range
- asociated with restoring homeostasis.

↓ (decrease of product)

Phone/Email/Notes

Notes



Sunday 07

* In positive feedback

- Less frequent
- Less asociated with stability
- Enhances change
- wider range
- asociated with vicious cycles. & death

↑ (Increased of product.

→ Water and electrolyte balance :-

- water and electrolytes balance is crucial for maintaining bodily function.
- electrolytes such Na, K, Cl^- play a vital role in fluid balance, nerve function muscle contraction.

→ Water and electrolyte needs to balance because,

1 fluid balance :-

→ electrolytes regulate body water distribution b/w cell and fluids.

2 nerve function :-

→ electrolytes Na^+ and K^+ transmit nerve impulses, enabling brain - body communication

3 muscle function :-

Ca and K are vital for muscle concentration contraction and relaxation, facilitating movement.

4 Acid - Base balance :-

→ electrolyte help maintain the body's PH.

→ blood pressure regulation.

→ specially Na and K play a significante role in blood volume and blood pressure

→ Regulation

→ Key electrolytes & their functions :-

1 Sodium :-

- It's primarily in extracellular fluid. fluid balance, nerve fun^{n}, blood pressure regulation

2 Pottassium :-

- nerve fun^{n} → muscle contraction
- help maintain fluid balance, acid-base balance

3 chloride :-

- work with Na and K to maintain fluid balance, acid-base balance

4 Calcium

- Crusial for muscle contraction nerve fun^{n}, blood clotting, bone health

5 Phosphate :-

- helps to maintain fluid, acid-base balance, energy production.

6 Magnesium :-

- involved in numerous bodily function including muscle contraction, nerve function, energy production.

→ Bicarbonate - help acid-base balance.

→ Regulation of water and electroly balances, tes

7 Kidney :-

- filtare fluids and electrolytes from blood.
- excreting excess in urine and retaining what body needs.

2 Hormones :-

- like antidiuretic hormone (ADH) and aldosteron reguate balance by influincing Kidney funn.

3 Thirst :-

- sensetion of thirst, triggered by dehydro genation, prompts fluid intake, helping to maintain adequate hydration.

1 Renin - Angiotensis - Aldesterone system (RAAS)

- Regulates blood pressure and bulance by influincing Na and H_2O Retention.

Date

→ Imbalances and Consequences

- Disruptions to this balance and can lead health issues:

1. dehydration

- insufficient water intake can lead to dehydration.
- characterised by electrolyte imbalance, and fating.

2. electrolytes Imbalances:-

Too much or too less of an electrolyte can disrupt bodily funn.

- leads to muscle cramps and other tissues.

→ ~~fa~~ Cause of water electrolyte Imbalance :-

- The balance of water and electrolytes in body can be disrupted by several factors.
- excessive sweating, diarhea, vomiting
- Kidney problem
- certain medication.

→ Ionic bases :-

Resting Membrane potential [RMP] :-

- electrical potential diff between (voltage) - outside / inside } of cell membrane under Resting condn
- also call :- Membrane potential
  - Transmem potential
  - " " difference
  - " " gradient
- when 2 electrode are connected to cathod ray oscilloscope placed over muscle fibre → zero potential
- but 1 electrode - inside
  1 " - over cell mem } → poten diff.

→ inside - negative } it is condition → RMP.
→ outside - positive } (polarized state)

in skeletal muscle → -90 mV

→ Ionic basis :-
maintain of RMP in - muscle fibre } by ions movements → produce ionic gradient
- neuron

→ by 2 factors

Na⊕ - K⊕ pump

- actively transport in opposite direction of cell mem
- it moves
  3 Na⊕ → out of cell
  2 K⊕ → inside of cell
- by using ATP

since,
- outside - more positive
- inside - more negative

selective permeability of cell mem

- depend upon transport channel
- most of ion gated channel (specific ion can move)
- 2 types of channels

for major anion (protein)
- non-actively charge substance
- [protein, phosphate sulphate]
- Remain inside the cell
- play major role in maintain negativity inside the cell

leak channel
- passive channel
- maintain RMP by positive ion (Na⊕, K⊕) movements
- → outside - Na⊕ and Cl⊖ ↑
- → inside - K⊕ ↑
- Cl⊖ channel - closed
- only move Na⊕ & K⊕

...tion potential (SH) :-

...ries of electrical changes → these occur in membrane potential → when muscle / nerve is stimulated.

→ occurs in 2 phase

① depolarization
- initial phase
- inside - positive charge
  outside - negative "

② Repolarization
- in muscle Reverse back to RMP.
- inside - negative } Re-
- outside - positive } establi...

→ Action-potential curve :-
- graphical Registration of electrical activity } - during excitable tissue } - [as muscle after stimulation]

3 major part

① latent period
- no changes in ele potential immediately after apply stimulus.
- 0.5 to 1 msec.

→ stimulus artifact
stimulus applied
↓
slight irregular deflection of baseline.

② depolarization
- it start after latent pe.
- initially it - very slow
- muscle depolarise - 15 mv

→ firing level :
- after slow depolarization of 15 mv (up to -15 mv)
- suddenly Rate of depolarization ↑ (its point called as -)

→ overshoot :-
- firing level to zero pot and then shoot up beyond zero pot (+55 mv)

③ Repolarization
- after complete of depo...
- Rep^n occurs Rapidly then become slow.

→ spike potential —
- Rapid Rise in depo^n }
+
- Rapid fall in Repo^n }
- [0.4 msec]

→ After depolarization / negative after potential
- slow Repolarization (2 to 4 msec)

→ After hyperpolar^n / positive after pot^n
- after Reaching -90 mv it becomes more negative beyond Resting level (50 msec.)
- after RMP → Restored slowly

→ Ionic bases :-

- voltage gated $Na^{\oplus}$ channel
- voltage gated $K^{\oplus}$ channel

① depolarization

- $Na^{\oplus}$ channel → opens
- slow influx of $Na^{\oplus}$
- fast influx of $Na^{\oplus}$ ($Ena^{\oplus}$ channel activation)
- when firing level
  influx is very ↑
  [it leads overshoot]

At Result outside - negative
inside - positive

② Repolarization

- $Na^{\oplus}$ Transport → stops slowed (bcoz Rapid inactivation of $Na^{\oplus}$ channel)
- At the same time
  $K^{\oplus}$ channel → opening [efflux of $K^{\oplus}$]
  ↓
  it causes Repolarization.

- At Result
  outside - positive
  inside - negative