

HUMAN ANATOMY & PHYSIOLOGY-II

UNIT 3 NOTES

RESPIRATORY SYSTEM

- ANATOMY OF RS
- MECHANISM OF RESPIRATION
- LUNG VOLUME & CAPACITY

URINARY SYSTEM

- ANATOMY OF URINARY TRACT
- KIDNEY & NEPHRONS
- PHYSIOLOGY OF URINE FORMATION
- ROLE OF RAS & KIDNEY



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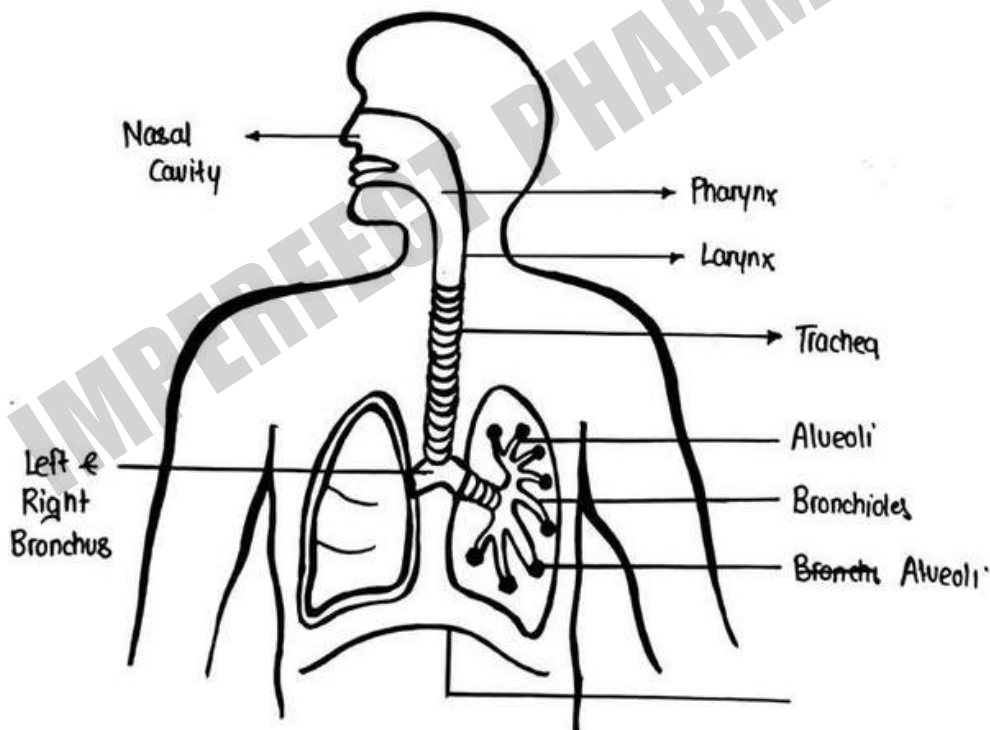
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RESPIRATORY SYSTEM

- Respiration is simply defined as process of exchange of gases b/w body tissues and external environment.
- Cells of our body continuously use oxygen for the metabolic reactions in which energy is released from nutrient molecules & ATP produces.
- Now during these metabolic reactions CO_2 also released that must be excreted out from body.
- The supply of O_2 & excretion of CO_2 occurs only through Respiration & the system that performs respiration is called Respiratory System.



Stages of Respiration

There are basically 3 stages of Respiration :

- ① Breathing / Ventilation
- ② Internal Respiration
- ③ Cellular Respiration

BREATHING : It is simply defined as the exchange of gases b/w environment & lungs.

INTERNAL RESPIRATION : It is simply defined as exchange of gases between lungs & blood

CELLULAR RESPIRATION : It is simply defined as exchange of gases between blood & body tissues (cells)

Types of Respiration

There can be two types of respiration :

- ① Aerobic Respiration
- ② Anaerobic Respiration

AEROBIC RESPIRATION :

- It occurs in the presence of oxygen.
- It always releases CO_2 & water.
- This process produces much more energy.

ANAEROBIC RESPIRATION :

- It occurs in the absence of oxygen.
- May or may not produces CO_2
- It produces less energy.

MECHANISM OF RESPIRATION

Mechanism of respiration involves two major steps :

- Breathing mechanism
- Exchange of Gases

Mechanism of Breathing

- The process in which air moves in & out of the lungs is known as Breathing.
- The breathing mechanism involves two major process :
 - ① Inspiration
 - ② Expiration

INSPIRATION

- The process of intake of atmospheric air is simply known as Inspiration.
- In this process air moves from atmosphere to lungs.
- The process is also known as Inhalation.
- It is an active process.

Muscles involved in Inspiration

Two types of muscles mainly involved in Inspiration.

- Diaphragm
- External - Inter - costal muscles

EXCHANGE OF GASES

- The gaseous exchange occurs in alveoli of lungs.
- It depends upon pressure difference b/w blood & tissues.
- Exchange of Gases takes place in following manner :
 - (i) Transport of Oxygen
 - (ii) Cellular Respiration
 - (iii) Transport of Carbon di Oxide

Transport of O_2

When O_2 is transferred from alveoli to blood then it is carried by Haemoglobin & then it is further transported to cells for cellular respiration.

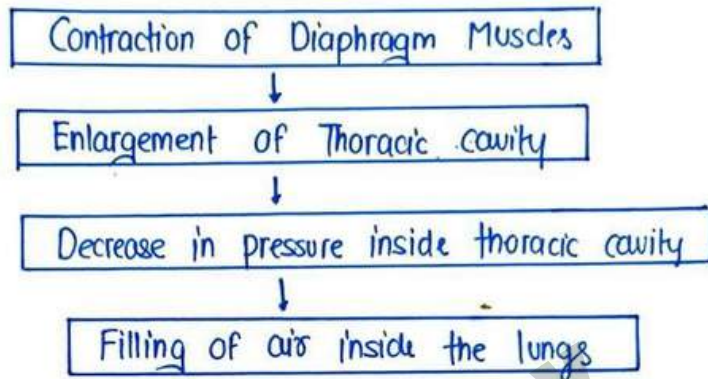
Cellular Respiration

The O_2 received by the cell is further used for the process of cellular respiration in which cells uses O_2 to breakdown the glucose into CO_2 & energy should be produced.

Transport of CO_2

Now CO_2 is a waste product hence it is further transferred from cells to blood & then blood to lungs & then finalled exhaled out.

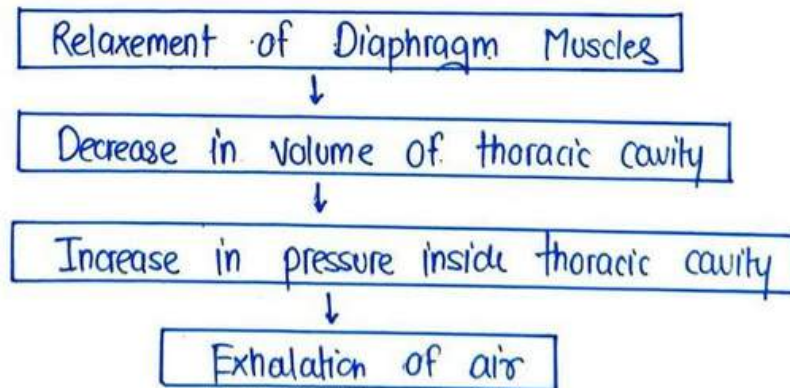
Inspiration Mechanism



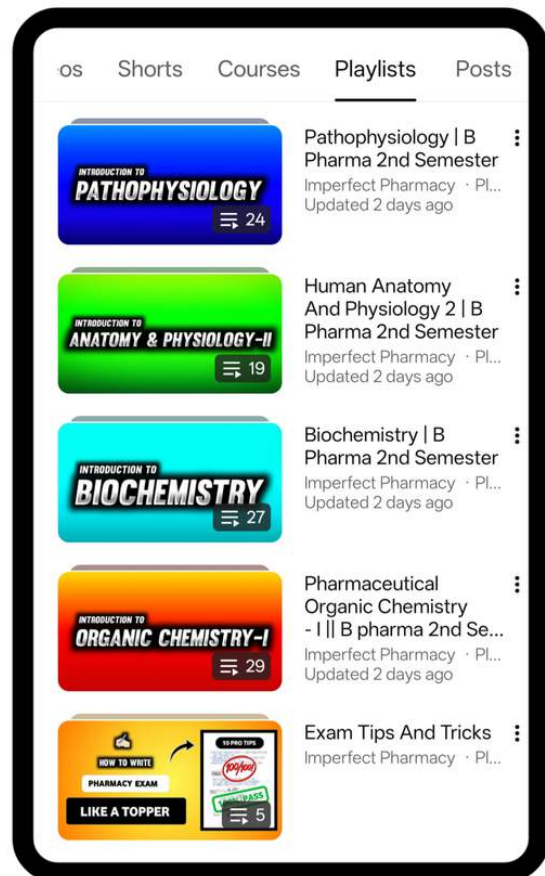
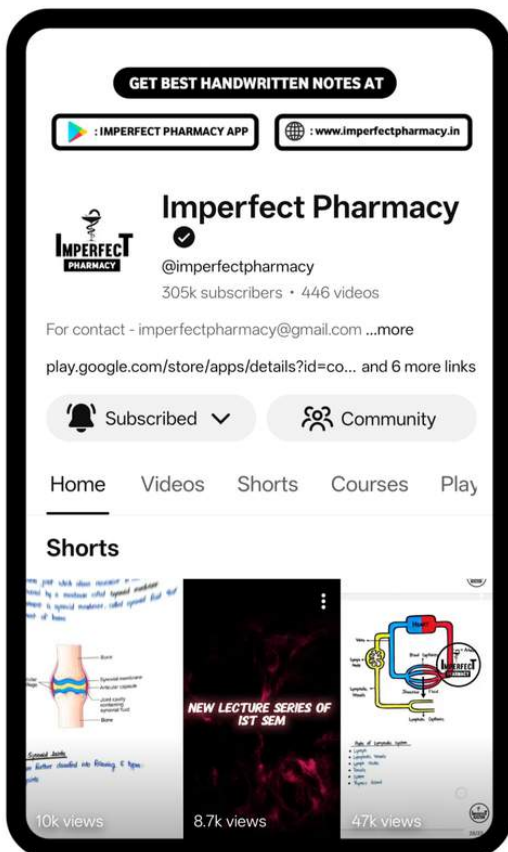
EXPIRATION

- The process in which the air moves from lungs to the atmosphere is known as Expiration.
- It is also known as Exhalation.
- It is a passive process (doesn't require energy)

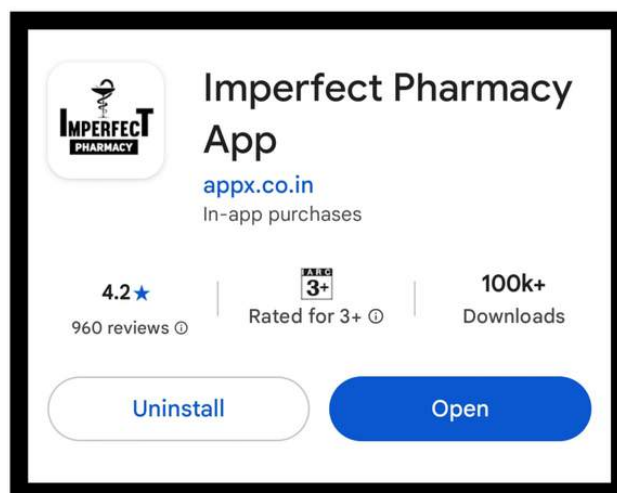
Expiration Mechanism



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REGULATION OF RESPIRATION

- The regulation of respiration refers to physiological mechanism that controls rate & depth of breathing to maintain appropriate levels of oxygen (O_2) & CO_2 in body.
- The regulation is essential for ensuring efficient gas exchange in lungs & maintaining Acid-Base balance in Bloodstream.
- There are two types of regulation of respiration :
 - ① Neural Regulation
 - ② Chemical Regulation

NEURAL REGULATION

- The neural regulation of respiration refers to control of breathing by neural circuits in brainstem, specially within medulla oblongata & pons.
- These neural centres coordinate & regulate the rhythm, rate & depth of breathing to ensure efficient gas exchange & maintain homeostasis of O_2 , CO_2 & pH levels in body.
- There are following neural centres that regulates respiration :
 - ① Dorsal Respiratory Group (DRG)
 - ② Ventral Respiratory Group (VRG)
 - ③ Pneumotaxic Centre
 - ④ Apneustic Centre

① Dorsal Respiratory Group

- It is present in dorsal portion of Medulla Oblongata.
- It controls basic respiratory mechanism.
- It primarily controls inspiration.
- It stimulates the diaphragm & external intercostal muscles.

② Ventral Respiratory Group

- It is present in ventral portion of Medulla Oblongata.
- During normal respiration it is inactive.
- It controls forceful respiration.

③ Pneumotaxic Centre

- It is located dorsally in upper pons.
- It controls switch off point of inspiration.

④ Apneustic Centre

- It controls Dorsal Respiratory Group.
- It delays switch off point of respiration.

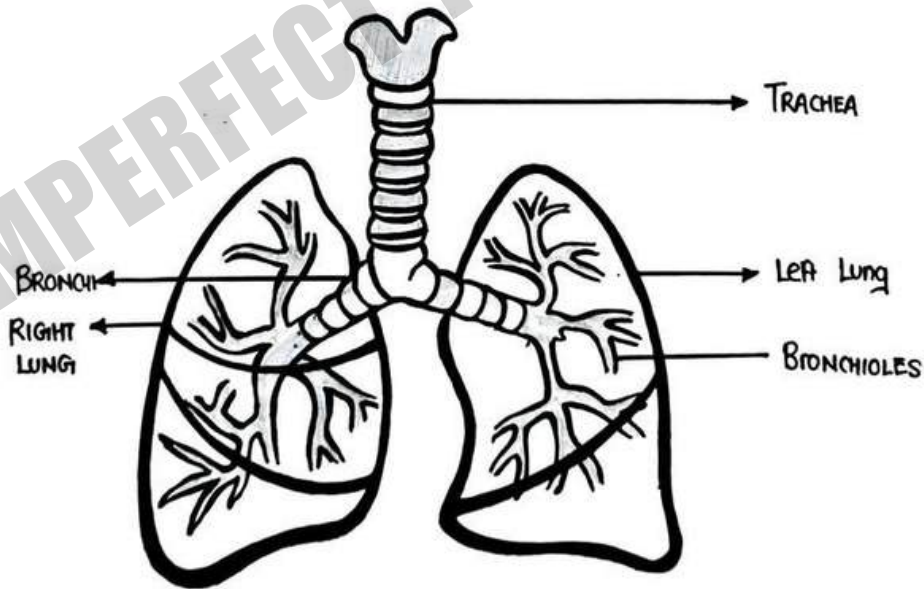
CHEMICAL CONTROL

- Chemical regulation of respiration refers to control of breathing rate & depth in response to changes in levels of gases & chemicals in bloodstream.
- These changes primarily involves oxygen (O_2), carbon dioxide (CO_2) & Hydrogen ion (H^+) concentrations, which are detected by specialized receptors throughout the body.
- In this rhythm centre activates & give signal to diaphragm to start inspiration.

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LUNGS

- Lungs are the principle organ of respiration.
- The lungs are pair of spongy air filled cone shaped organ located on either side of chest.
- They are present in pair i.e. left lung & right lung.
- Lungs are covered by a double membrane known as Pleural membranes.
- Outer Membrane : Parietal Pleura
- Inner Membrane : Visceral Pleura
- Between both the membranes a fluid is present known as Pleural fluid.
- The left lung is slightly smaller than right lung.
- Right lung has three lobes while left lung has only 2 lobes.



Surfaces Of Lungs

The lungs can be divided into 4 parts.

- Apex : Narrow Superior portion
- Base : Broad Inferior portion.
- Costal : Surface against ribs
- Surface : lateral boundary of Mediastinum.

Lobes of Lungs

Lungs of each side contains different no. of lobes :

RIGHT LUNG : Right lung is subdivided into 3 lobes :

- Superior Lobe
- Middle Lobe
- Inferior Lobe

LEFT LUNG : Left Lung is subdivided into 2 lobes :

- Superior Lobe
- Inferior Lobe

LUNG VOLUMES

- Lung volumes are also known as respiratory volumes.
- It refers to the volume of gas in the lungs at a given time.
- There are various types of Lung volumes :
 - ① Tidal Volume
 - ② Inspiratory Reserve Volume
 - ③ Expiratory Reserve Volume
 - ④ Residual Volume

Tidal Volume

- It is simply defined as amount of air inhaled or exhaled during normal breath.
- Its value is about 500 ml

Inspiratory Reserve Volume

- It is the maximum amount of air inhaled by a deep inspiration process.
- Its about 2500 - 3000 ml.

Expiratory Reserve Volume

- It is simply defined as maximum amount of air exhaled by a deep expiration process.
- Its about 1000 - 1200 ml

Residual Volume

- It is the amount of air that remains inside lungs after forceful exhalation. 1200 - 1500 ml

LUNG CAPACITY

- Lung capacities are derived from summation of different lung volumes :
 - They are also of different types :
- (i) Total lung capacity
 - (ii) Vital capacity
 - (iii) Expiratory capacity
 - (iv) Residual Capacity
 - (v) Inspiratory Capacity

Total Lung Capacity : • Total volume of air that person can hold in its lungs after a forced inhalation.
• Sum of all volumes. M → 6000 ml F → 4500 ml

Vital Capacity : • It is amount of air that a person move in & out.
• Sum of tidal volume & inspiratory reserve volume & expiratory reserve v.

Inspiratory Capacity : • Amount of air that can be inhaled after tidal Volume, expiration.
• Sum of tidal volume & inspiratory reserve volume.

Expiratory Capacity : • It is simply amount of air exhaled by a person.

Residual Capacity : • Amount of air remains after a normal tidal expiration.
• Sum of expiratory reserve volume & residual volume.

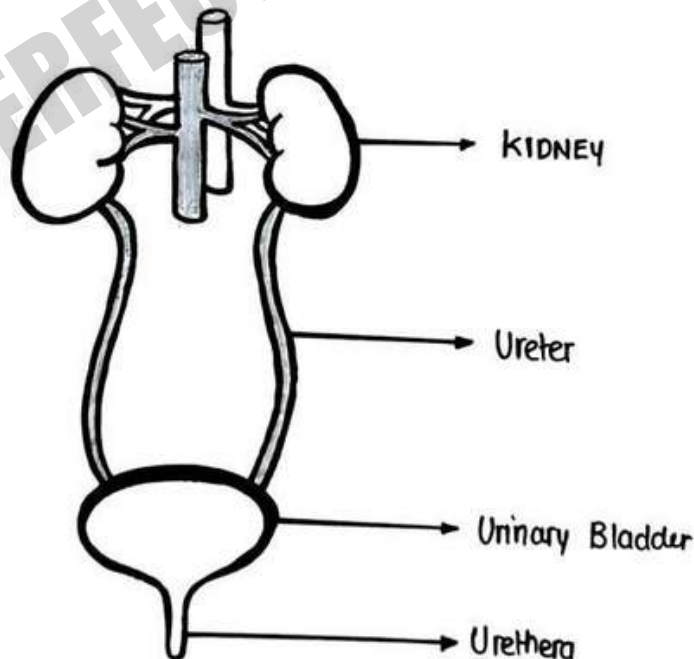
URINARY SYSTEM

- Excretion is the process by which unwanted substances & metabolic wastes are eliminated from the body.
- Although there are various systems in our body that are involved in the excretion process, but Urinary System has major excretory capacity, hence it is known as major excretory system of human body.
- It is also known as Renal System.

Parts of Urinary System

Urinary System mainly consist of :

- A pair of kidneys
- Ureters
- Urinary Bladder
- Urethra



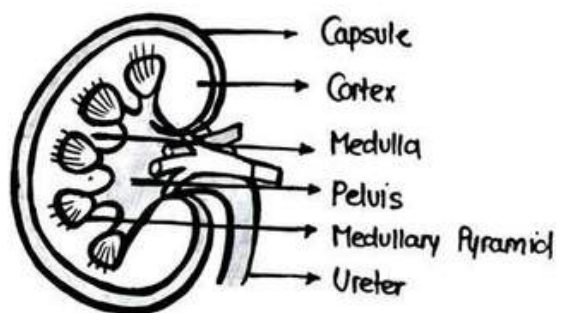
KIDNEY

- They are present in a pair in our body.
- Kidneys are two bean shaped organ located on each side of vertebral column. (T-12 - L3).
- It is Reddish-brown in colour.
- It is about 10-12 cm long & 5-7 cm wide.
- Its weight is about 120-170 gram.

Layers of kidney

Kidney mainly contains 3 layers:

- ① Outer Cortex
- ② Inner Medulla
- ③ Renal Pelvis



NEPHRONS

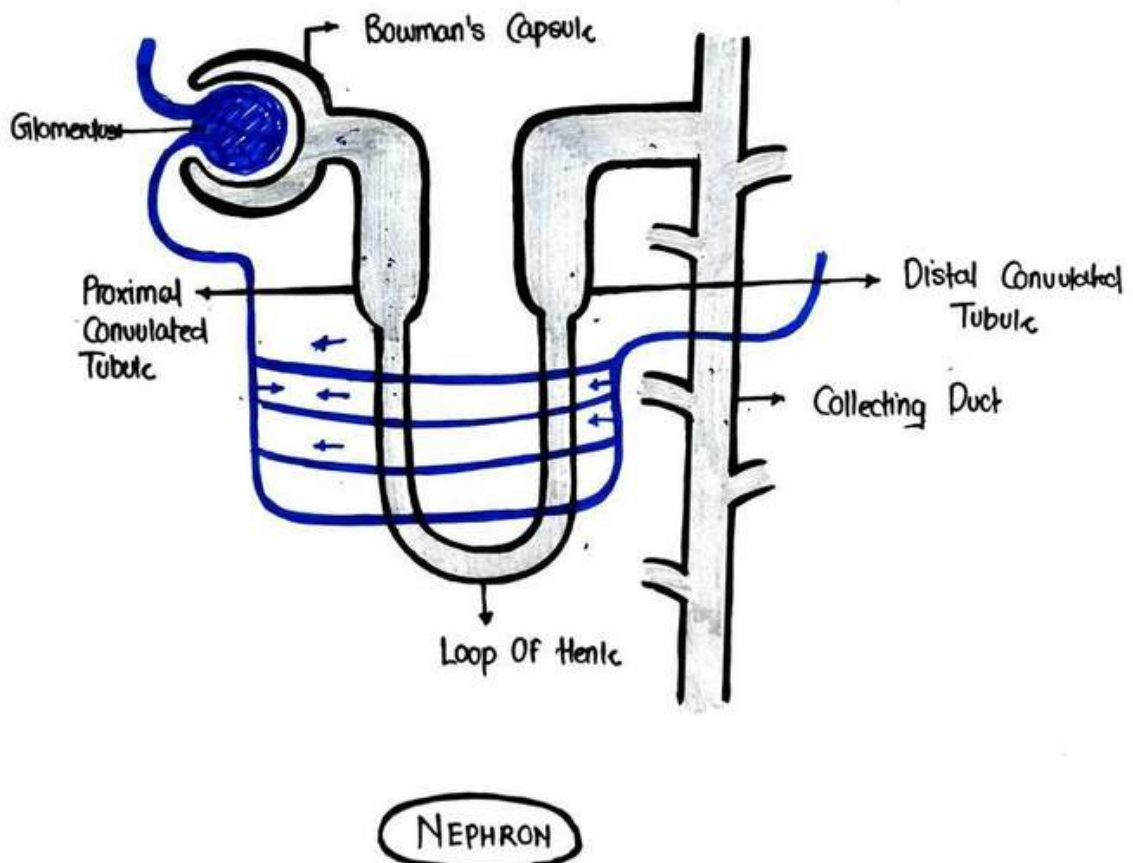
- Nephrons are the major functional unit of kidney.
 - Nephron is mainly consist of two parts:
- ① Renal Corpuscle
 - ② Renal Tubule

RENAL CAPSULE CORPUSCLE

- It is present in the cortex of kidney.
 - The major function of renal corpuscle is filtration of blood.
 - It can be further subdivided into two portions
- ① Glomerulus : Bunch of capillaries.
 - ② Bowman's Capsule : Upper end of renal tubule.

RENAL TUBULE

- It is a tube like structure and the continuation of Bowman's capsule.
- Proximal & Renal tubule mainly consist of 3 parts :
 - ① Proximal Convuluted Tubule : Present in Cortex
 - ② Loop Of Henle : Present in Medulla
 - ③ Distal Convuluted Tubule : Present in Cortex
- Loop of Henle can be further subdivided into 2 parts :
 - (i) Descending Limb
 - (ii) Ascending Limb



Types Of Nephrons

Nephrons are of basically two types :

- ① Cortical Nephrons : 85% , short Loop of Henle
- ② Juxta - Medullary Nephrons : 15% , Long Loop of Henle.

PHYSIOLOGY OF URINE FORMATION

- Urine formation is a Blood Cleansing Function.
- Normally about 1300 ml of blood enters into the kidney.
- Kidney excreted the unwanted substances from the blood as Urine.
- Normal Urine output is 1-1.5 Litre/day.

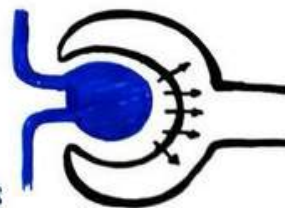
Formation Of Urine

It mainly involves 3 steps :

- ① Glomerular Filtration
- ② Tubular Reabsorption
- ③ Tubular Secretion

① GLOMERULAR FILTRATION

- It is a process by which blood is filtered while passing through glomerular capillaries by filtration membrane.
- It is first step of Urine formation.
- When blood passes through glomerular capillaries the plasma is filtered in Bowman's capsule.
- All the substance of plasma filtered in glomerular filtration except plasma protein & filtered fluid is known as Glomerular filtrate.



Glomerular Filtration Rate

- Glomerular Filtration rate (GFR) is defined as total quantity of filtrate formed in all the nephrons of both the kidney in the given unit of time.
- Normal GFR is 125 ml / minute or 180 L / day

Factors Affecting GFR

- Renal blood flow
- Glomerular capillary Pressure
- Colloidal Osmotic Pressure
- Hydrostatic pressure in Bowman's capsule.

② TUBULAR REABSORPTION

- As we clearly saw that about 180 L filtrate formed per day but only 1.5 litre urine is excreted out from our body that means about 99% part of filtrate again reabsorbed in blood.
- It is the process by which water & other necessary substances are reabsorbed from Renal Tubule to Blood.
- The reabsorbed substances moves into the interstitial fluid of renal medulla & after that they moved into ~~cap~~ tubular capillaries.
- Tubular reabsorption is a selective reabsorption as the tubular cells reabsorb only those substances that are necessary for our body.
- Essential substances get reabsorbed while unwanted substances excreted out from body.

Site of Reabsorption

PROXIMAL CONVULATED TUBULE	LOOP OF HENLE	DISTAL CO. TUBULE
Glucose , Amino Acids Sodium , Potassium Calcium , Bicarbonates Chlorides , Phosphates Urea , Uric Acid Water	Sodium Chloride	Sodium Calcium Bicarbonates Water

③ TUBULAR SECRETION

- It is process in which substance are transported from blood to renal tubules .
- The unwanted substances that are not get filtered from blood to Bowman's Capsule in first step are directly transported to renal tubules later in this process .

Substance secreted in different segment of renal capsule tubule

- Proximal Convulated Tubule : Potassium , Ammonia , H^+ ions
- Loop of Henle : Urea
- Distal Convulated Tubule : Potassium , H^+ ions
- Collecting Ducts : Potassium

FUNCTIONS OF KIDNEY

- It helps in the excretion of waste products.
- It maintains water- electrolyte balance.
- It maintains acid- base balance.
- It also helps in the process of erythropoiesis by secreting erythropoietin & also in thrombopoiesis by secreting thrombopoietin.
- It secretes renin, prostaglandin hormones.
- It also helps in regulation of blood pressure.
- It also regulates blood- calcium level.

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ROLE OF KIDNEY IN ACID BASE BALANCE

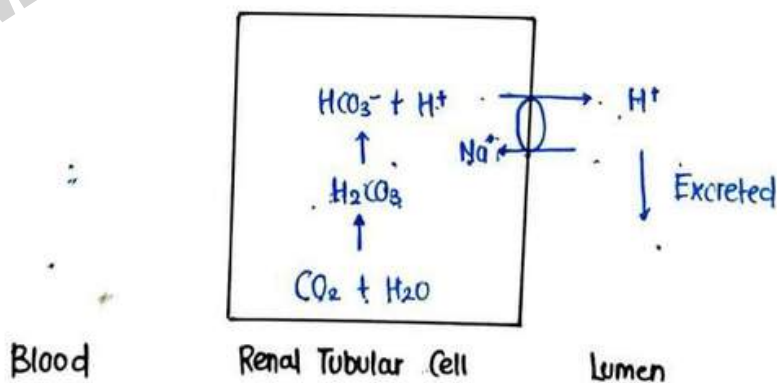
- Acid base balance is a part of homeostasis process that deals with maintenance of pH
- Most of the reactions in our body occur at a specific pH & change in this pH can lead to major disturbances.
- The normal pH value of blood is approx 7.42 & survival range of pH in blood is between 7.38 - 7.42, now if the pH limit crosses this value then it may lead to death, so it becomes very important to maintain pH balance of our body.
- Now, there are various mechanisms in our body to regulate this acid-base balance but the renal mechanism is the most effective & final process of acid-base balance in which kidneys play a major role.

Renal Mechanism of Acid base balance

It mainly works by 2 mechanisms:

- Excretion of H^+
- Reabsorption of bicarbonate ions

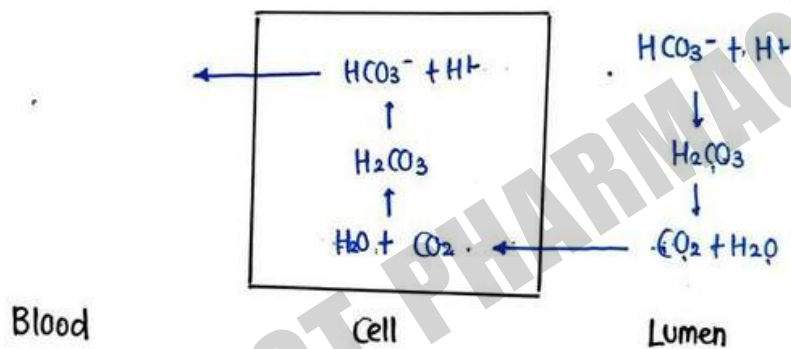
Excretion of H^+



STEPS

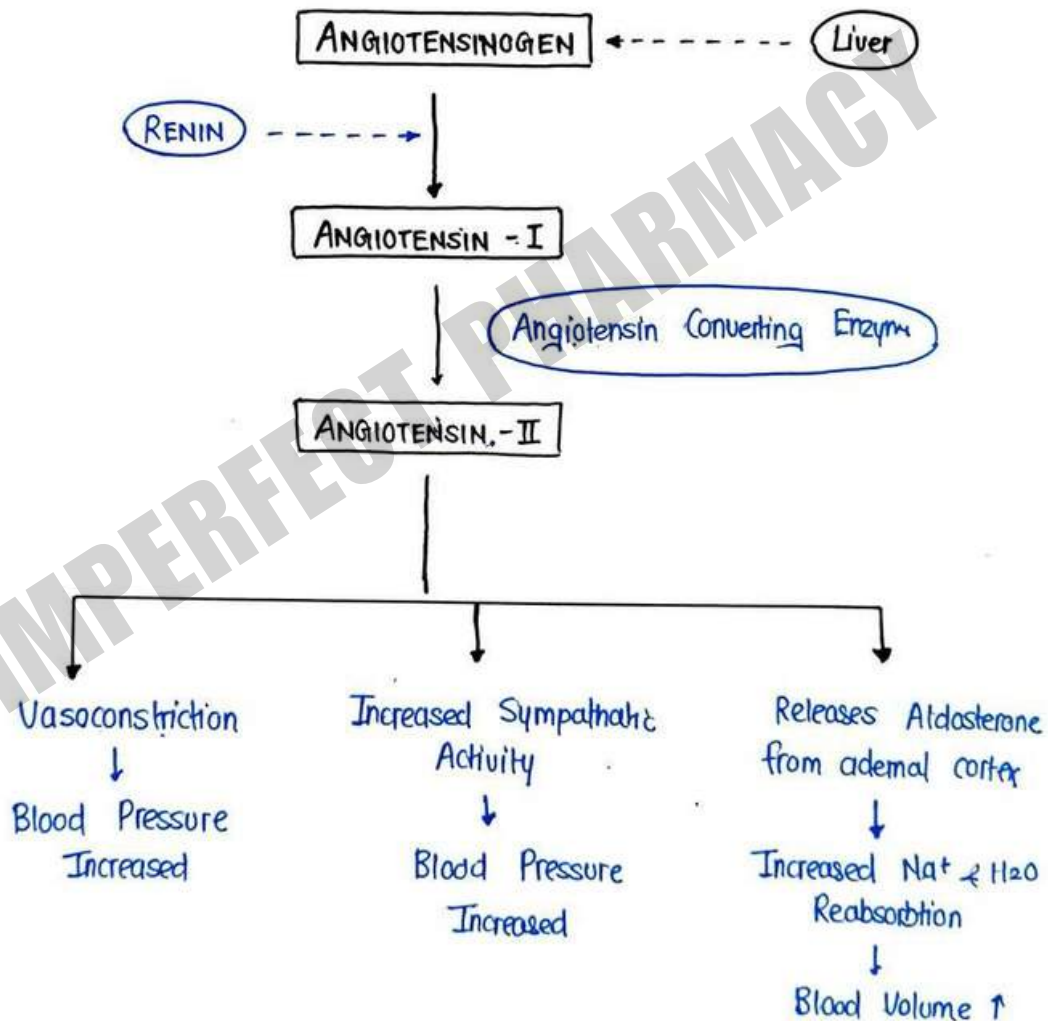
- This step mainly occurs proximal tubule.
- CO_2 combines with H_2O to form H_2CO_3
- Now H_2CO_3 dissociates into HCO_3^- & H^+
- H^+ is secreted in Lumen in exchange to Na^+
- Now this H^+ is excreted out from body through urine.

② REABSORPTION OF BICARBONATE IONS



ROLE OF RAS In kidney

- RAS stands for Renin Angiotensin System.
- Renin Angiotensin system is a physiological hormone system involved in the regulation of arterial blood pressure & plasma sodium concentration
- Renin is a hormone secreted by Juxtaglomerular Apparatus.
- Angiotensinogen is a plasma protein released by liver



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