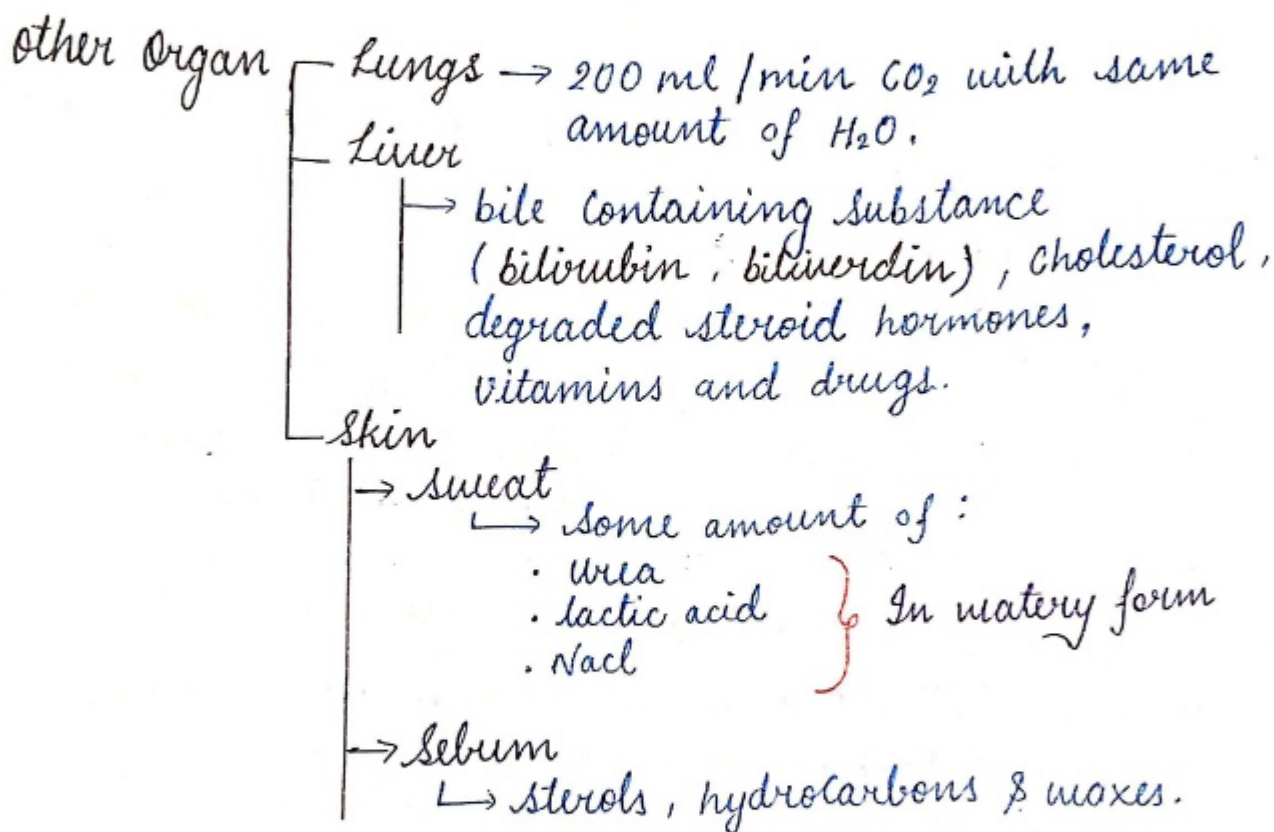


# Excretory Products and, Their Elimination

## EXCRETION

Def<sup>n</sup>: Removal of waste material specially nitrogenous waste.

Eg:  $\text{NH}_3$ , uric acid & urea called excretion.



\* Ammonotelic: eg  $\rightarrow$  Bony fishes (*Osteichthyes*), Aquatic amphibians and insects

$\downarrow$   
Excrete  $\text{NH}_3$  as nitrogenous waste

\* Ureotelic: eg  $\rightarrow$  Terrestrial amphibians, marine fish & mammals. (*Cartilaginous fish*)

$\downarrow$   
Excrete urea as nitrogenous waste

\* Uricotelic : eg → Reptiles, birds, land snail & Insects

↓  
excrete uric as in the form of  
Pellet or Paste as nitrogenous waste.

### EXCRETORY ORGAN

→ Simple tubular structure → Invertebrate

→ Complex tubular structure → Vertebrate

|        |                 |   |                                                         |
|--------|-----------------|---|---------------------------------------------------------|
| Phylum | Porifera        | → | general body surface by diffusion                       |
|        | Coelenterata    | → | "                                                       |
|        | Ctenophora      | → | "                                                       |
|        | Platyhelminthes | → | flame cells.                                            |
|        | Aschelminthes   | → | solenocyte or Protonephridia<br>H-shape excretory tube. |
|        | Annelida        | → | nephridia                                               |
|        | Arthropoda      | → | Malpighian tubule                                       |
|        |                 | ↓ | Class Insecta or Insects.                               |
|        |                 | → | Antennary<br>or<br>green gland → Prawn.                 |
|        | Mollusca        | → | feather like gills                                      |
|        | Echinodermata   | → | ab.                                                     |
|        | Hemi-Chordata   | → | Proboscis gland                                         |
|        | Chordata        | → | kidney                                                  |

\* In annelida & Cephalochordata - protonephridia,  
primary concern with Osmoregulation & ionic balance.

\* Uric acid & Urea → production in body. This is  
terrestrial adaptation.

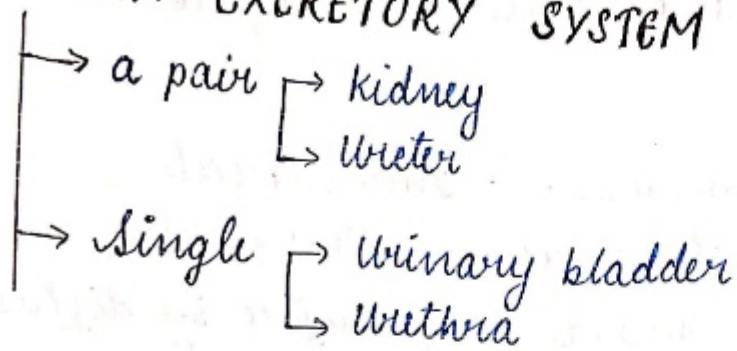
\*  $\text{NH}_3$  excrete through gills by simple diffusion

\* Kidney not involved in excreting of  $\text{NH}_3$ .

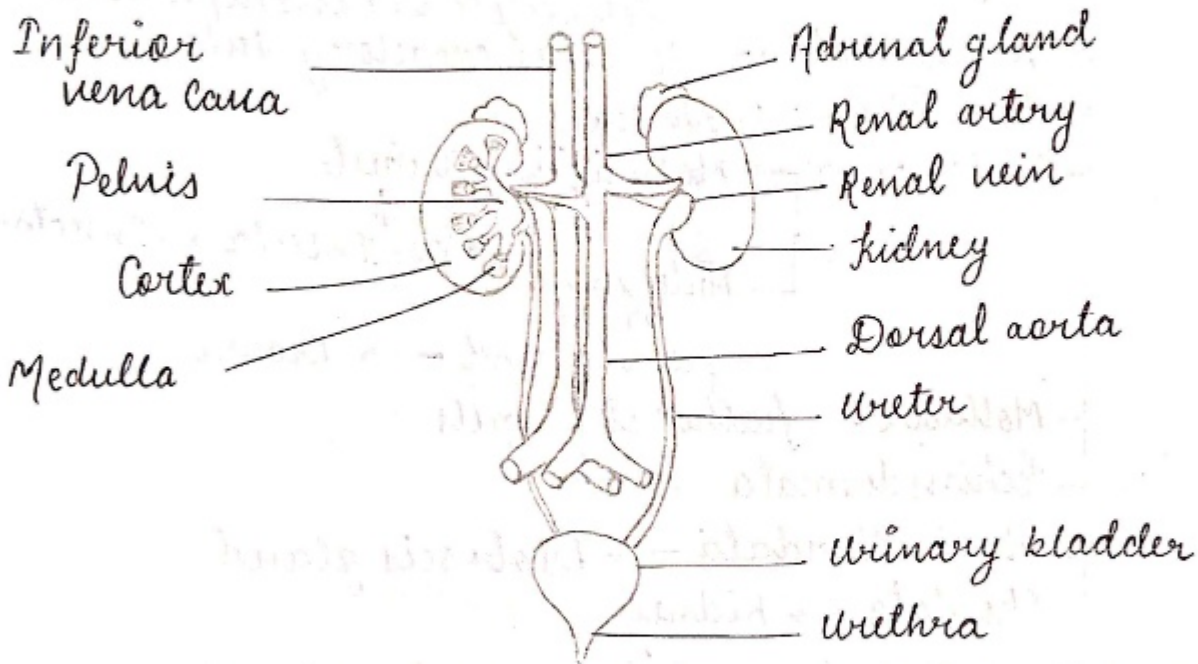
\* If ammonia produced in body converted into urea by  
Ornithine cycle in liver & excrete out by kidney.

They excrete  $\text{NH}_3$  in water & urea in terrestrial environment.

## → HUMAN EXCRETORY SYSTEM

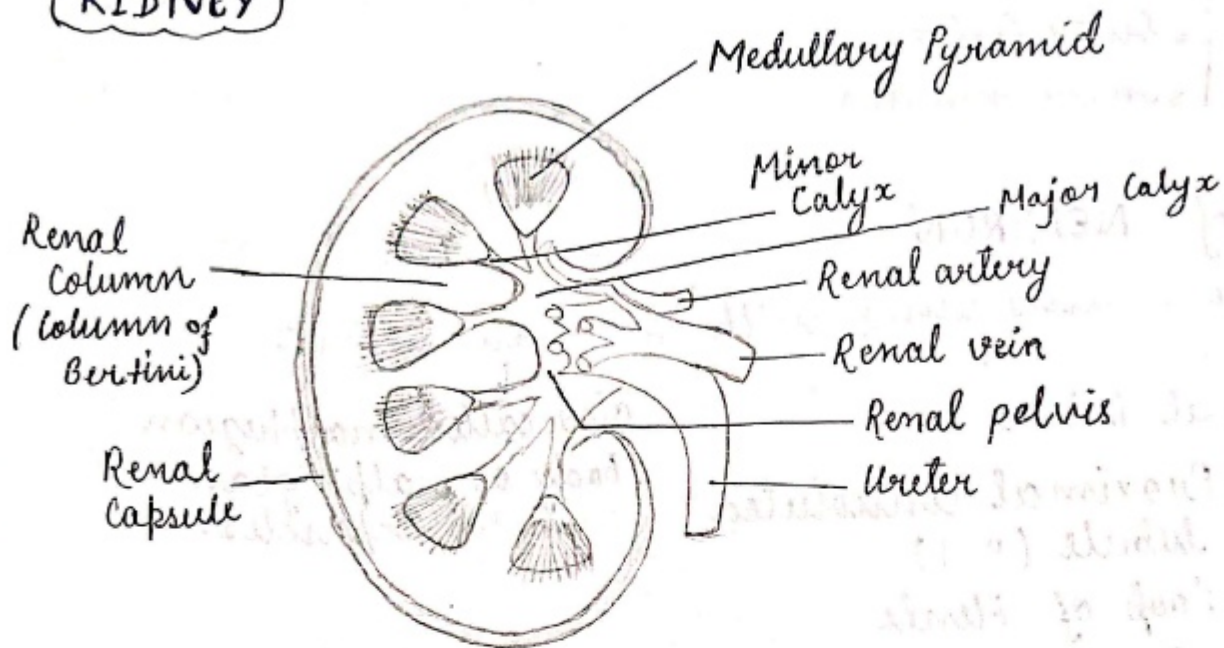


### KIDNEY



Human Urinary System

# KIDNEY



## Structure of kidney

- Unit Nephron
- One kidney → 1 million or 10 lakh
- Shape → Bean
- Size
  - length → 10-12 cm
  - width → 5-7 cm
  - Thickness → 2-3 cm
- Colour → Reddish brown
- Weight → 120-170 g
- Functions to → urine formation
- Position → larger Thoracic third lumbar  
close to dorsal inner wall.

### \* Hilum

↳ A Concave notch through which blood vessels (renal artery & vein), nerve & ureter enter into kidney.

### \* Pelvis

Funnel shaped structure with major & minor calyx.

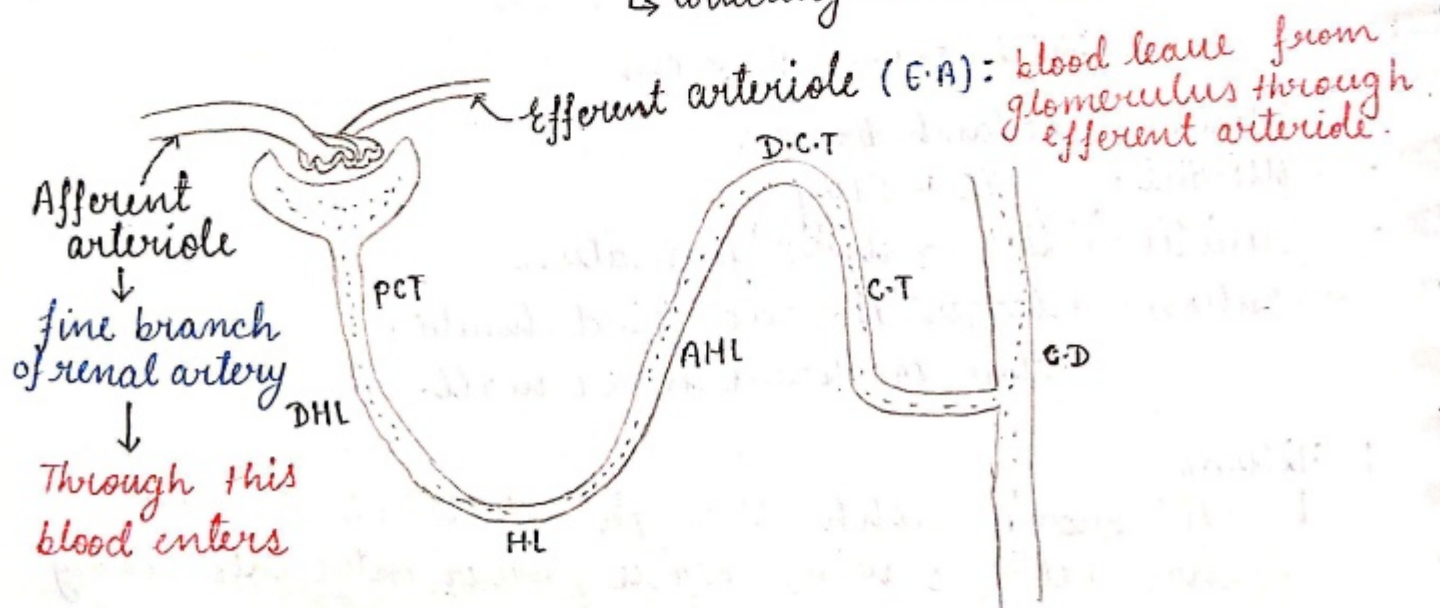
Kidney → Capsule → outermost  
 → Outer Cortex  
 → Inner medulla

## \* Part of NEPHRON

→ Glomerulus along with Bowman's capsule  
 ↓  
 also called malphigian body or malphigian corpuscles.  
 → Renal tubule  
 → Proximal Convoluted tubule (PCT)  
 → Loop of Henle  
 → Descending Henle's loop (DHL)  
 → Ascending Henle's loop (AHL)  
 → Distal Convoluted tubule (DCT)

*These are anatomical i.e. structural & functional part of a nephron.*

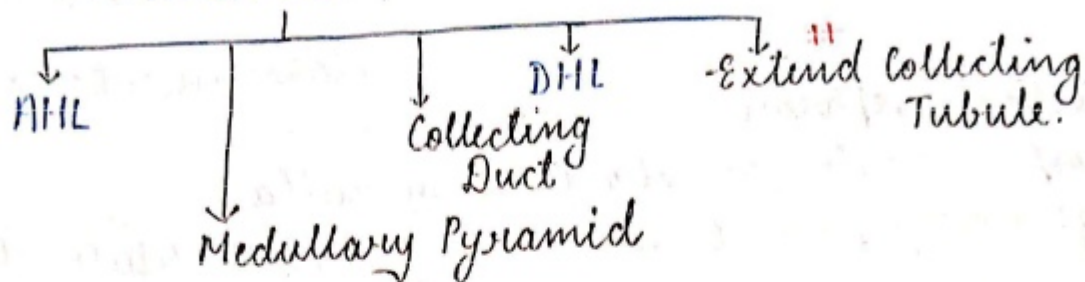
# Other functional part → Collecting tubule (CT)  
 → Collecting duct (CD)



→ Nephron part present in Cortex & Medulla

① Cortex → <sup>(Glomerulus)</sup> Malpighian body, PCT, DCT  
# Starting of C.T

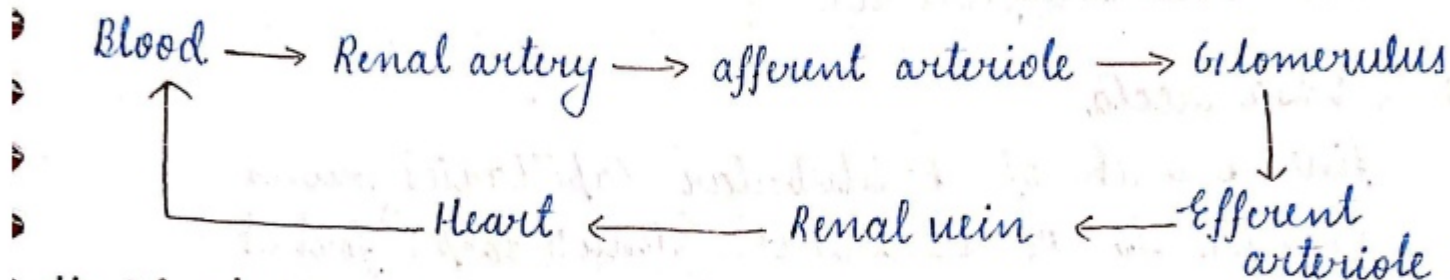
② Medulla → Henle's loop



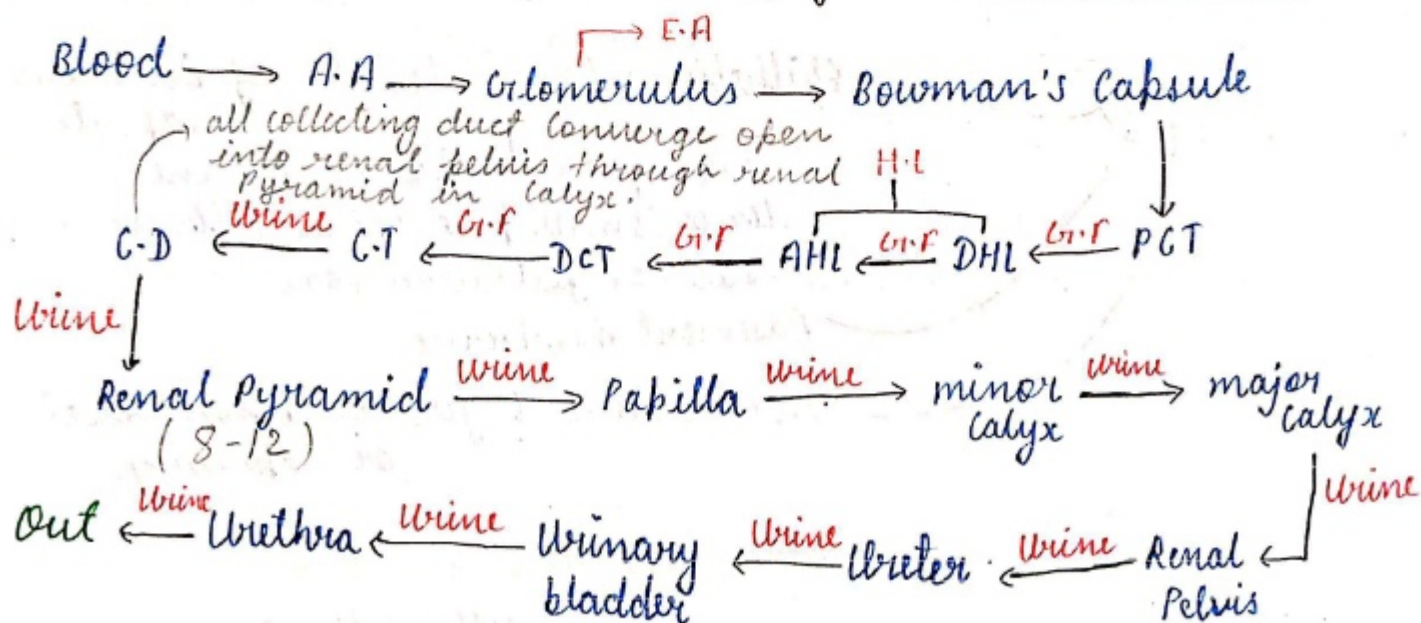
apex of Pyramid or Tip of Pyramid

Renal Papilla

→ Flow of blood



# Blood flow, Urine formation & flow in renal tubule



## + → Types of Nephron

### ① Juxta Medullary Nephron

: loop of Henle deep into medulla & also have vasa recta  
eg: mostly present in desert animal — camel and kangaroo rat etc

↓  
Make Concentrate urine

### ② Cortical Nephron

: loop of Henle too short in medulla.

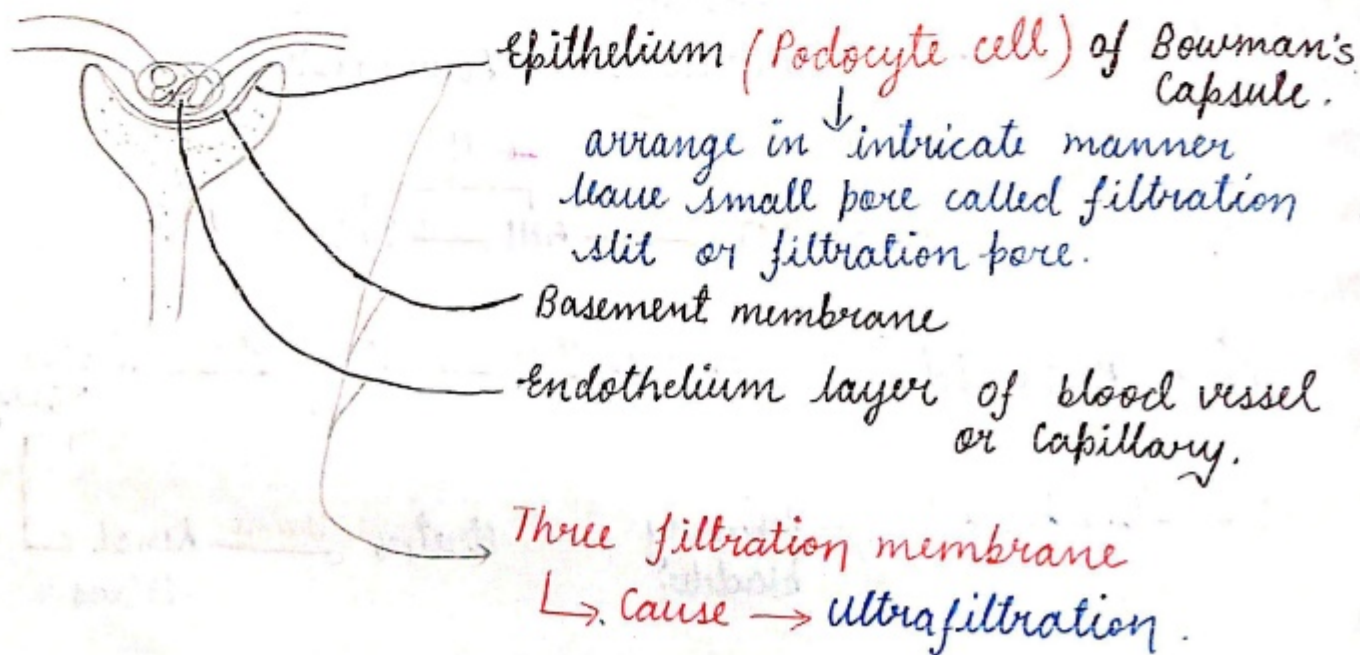
eg: mostly present in Humans → Make dilute urine

## + → Peritubular Capillaries

Efferent arteriole emerge out from glomerulus and form network of capillaries called Peritubular capillaries.

## + → Vasa recta

fine branch of Peritubular capillaries runs parallel to renal tubule (Henle's loop) forms vasa recta.



## → Formation of urine

### ① ultrafiltration

- about 1100 ml to 1200 ml blood pumped by heart to both kidney in a minute which is 1/5<sup>th</sup> part of total blood pumped by heart.
- Three membrane participate in ultrafiltration
- about 125 ml glomerulus filtrate produce in a minute.
- In a day 180 litre glomerulus filtrate produce.

# How Glomerulus filtration takes place?

↓  
Due to pressure

→ ① Glomerulus Capillary Hydrostatic pressure.  
⇒ +60

→ ② Bowman Capsule Hydrostatic pressure  
⇒ -15

→ ③ Glomerulus Capillary Oncotic  
(Osmotic Colloidal) pressure = -30  
or  
blood Colloidal Osmotic Pressure

→ Net filtration pressure  
or effective filtration Pressure.

$$\begin{aligned}NFP &= P_{GC} + (-P_{BC}) + (-\pi_{OC}) \\&= +55 + (-15) + (-30) \\&= 10\end{aligned}$$

$$10 = 20$$

- \* Glomerulus filtrate → All Constitute of Plasma  
except protein
- \* Glomerulus filtration → 125 ml/min

## ② Reabsorption

- about 99% glomerulus filtrate reabsorbed i.e. 178.5 glomerulus filtrate absorb & only 1.5 litre act as urine.
- absorption takes place by active & passive method.
  - active → used of energy (ATP)
  - Passive → not used of energy.

+ → Active absorption → Sodium, glucose & Amino acid.

+ → Passive absorption → water & Nitrogenous waste (Urea)

↓  
Maintains osmotic pressure of blood.

## ③ Secretion

- takes place by tubular epithelial cells to maintain pH and ionic balance of the fluid (blood).
- Secretion →  $H^+$  (Proton) or Hydrogen ion, Potassium ion ( $K^+$ ) & Ammonia ( $NH_3^+$ ).

+ → Tubular Secretion & absorption

Tubular part → PCT, HL, DCT, CT, CD

### 1) Proximal Convoluted Tubule (PCT)

- lined by cuboidal epithelium
  - ↓  
form brush border epithelium
  - ↓  
which increases absorptive surface area
- 70 to 80% electrolyte absorbed by in PCT
- maintains pH & ionic balance.

Secretion

- $H^+$
- $K^+$
- $NH_3$

Absorption

- $HCO_3^-$

## 2) Henle's Loop (HL)

- Ascending Henle's Loop (AHL) → permeable for  $H_2O$  and impermeable for ions i.e. make dilute fluid.
- Descending Henle's Loop (DHL) → permeable for ions & allow ion actively and passively.

## 3) Distal Convoluted tubule (DCT)

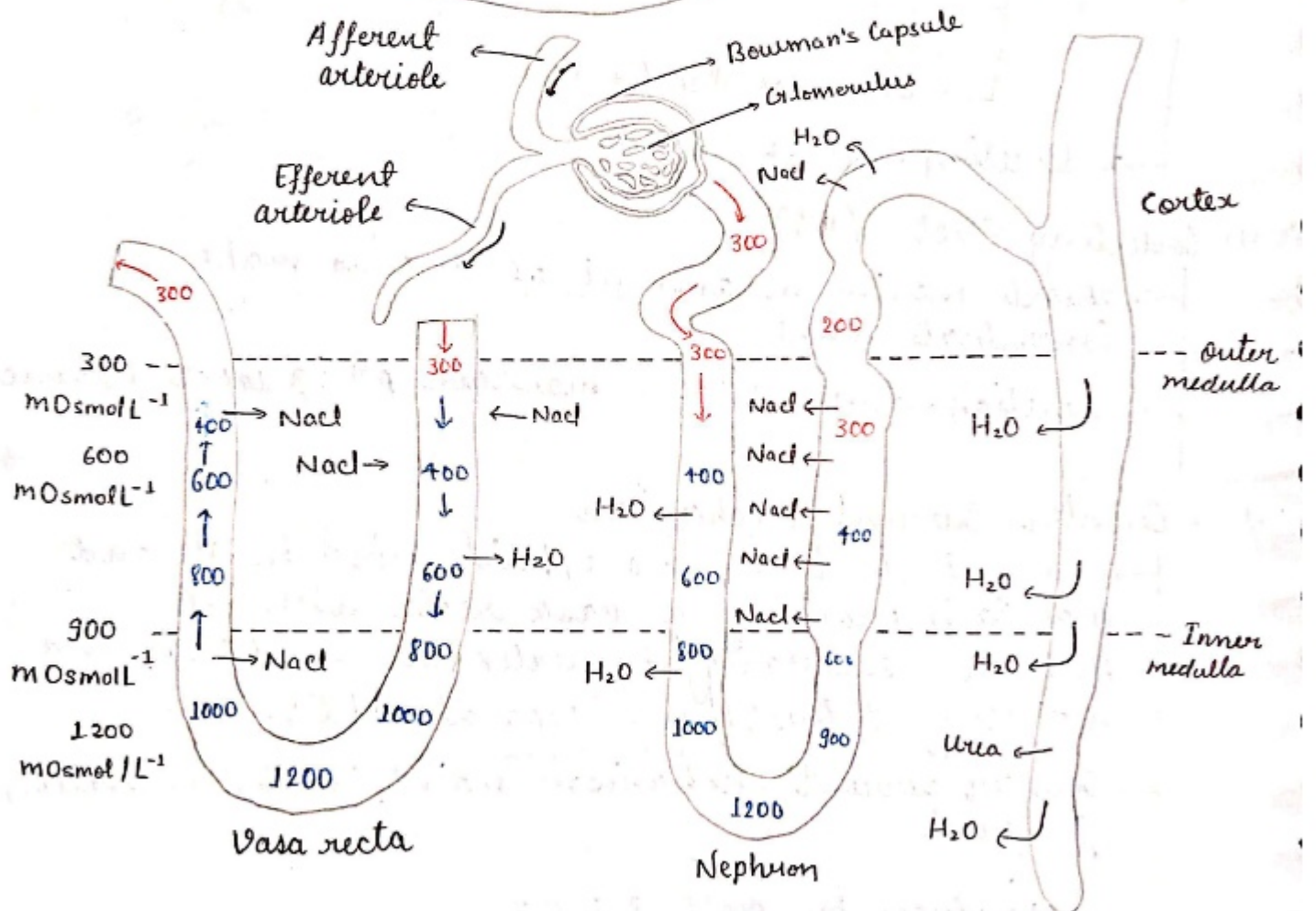
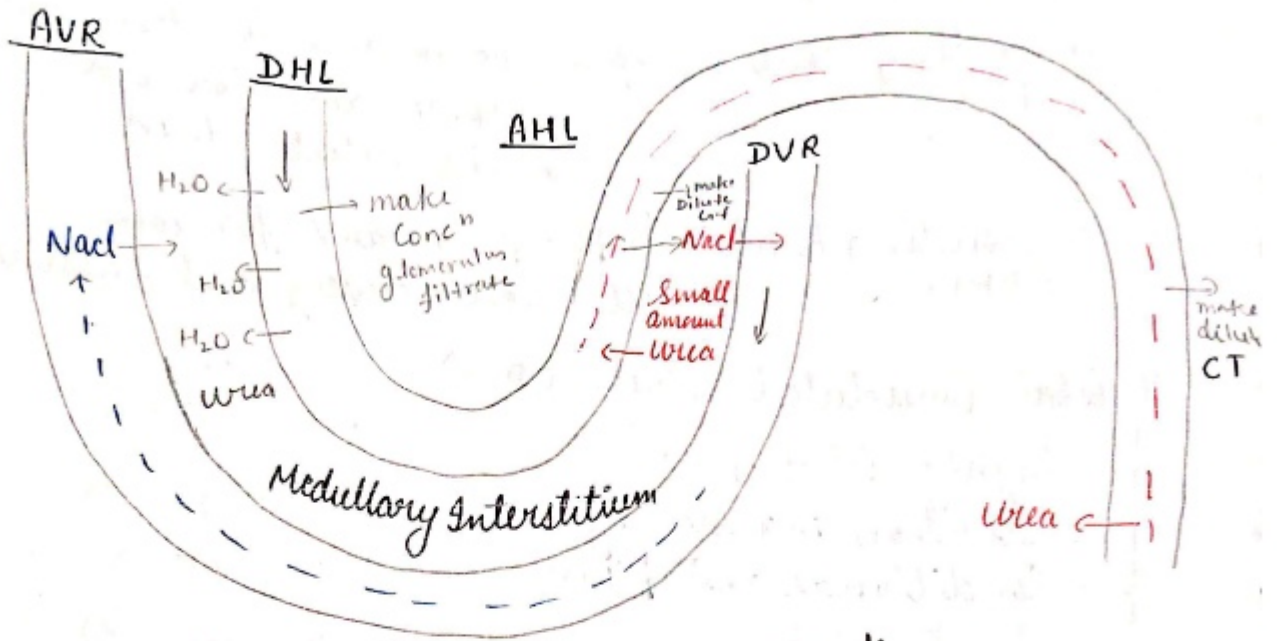
- highly coiled part
  - secretion mainly by DCT
  - Conditional absorption
    - $Na^+$
    - $H_2O$
    - and also absorbs  $HCO_3^-$
  - Secretion →  $H^+$ ,  $K^+$  &  $NH_3$
- Maintains pH &  $Na^+$ ,  $K^+$  in blood.

## 4) Collecting Duct (CD)

- absorb maximum amount of  $H_2O$  to make concentrate urine.
- Secretion →  $H^+$ ,  $K^+$  → maintain pH & ionic balance

## + → Counter Current Mechanism

- Flow of fluid in two opposite dir<sup>n</sup> in HL and maintain Proximity of vasa recta with HL maintain Osmolarity in cortex 300 Osmol/lit and medullary Interstitium 1200 Osmol/lit.
- ★ → Counter current mechanism maintain concentration gradient
  - ↓
  - produces by NaCl & urea.



*Nephron and Vasa recta showing Counter Current mechanisms*

Small amount of urea

↓  
AHL

↓  
Enter into Medullary Interstitium

↓  
By Collecting tubule

↓  
which ↑ medullary Interstitium osmolarity

↓  
urea return back to fluid body

↓  
AHL

NaCl

↓

Transport

↓

AHL

↓

Exchange

↓

DVR

↓

i.e NaCl return back to blood.

→ In counter current mechanism vasa recta act as exchanger while HL act as multiplier.

→ Due to reabsorption, secretion and the presence of counter current mechanism in human are able to make 4 time concentrate urine than the initial fluid.

→ Counter current mechanism present in the juxta Medullary Nephron, counter current mechanism make the concentrate urine.

→ Cortical Nephron make the dilute urine.

- Regulation of kidney  
(Hormonal feedback mechanism of kidney)
- By Juxta Glomerulus Apparatus present in kidney itself  
(JGA)
- By Hypothalamus part of Diencephalon of Forebrain
- Certain extent of heart
  - ↳ When blood pressure  $\uparrow$ es the heart auricle or atria secrete atrial natriuretic factor (ANF) which check the renin angiotensinogen system means neglect the effect of  $\uparrow$ as cause vasodilation i.e.  $\uparrow$ es the diameter of blood vessels / capillary thereby blood pressure  $\downarrow$ es.

Juxta Glomerulus Apparatus (JGA)

↳ It is special sensitive region formed by cellular modification of afferent arteriole and Distal Convoluted Tubule (DCT) at the location of their contact.

→ Working

Fall in glomerulus filtration rate (GFR)

↓  
Activate Juxta Glomerulus cell of Juxta Glomerulus Apparatus (JGA)

↓  
Release / secrete Renin Hormone

↓  
Renin Convert angiotensinogen I & II

↓  
Angiotensinogen II is Powerful Vasoconstrictor

↓  
Contract blood vessel / capillary

↓  
which  $\uparrow$ es the Blood Pressure

↓  
Thereby glomerulus filtration rate maintain (GFR)

blood vessel / capillary

↓  
Vasocontract

### → Controlling by Hypothalamus

change in body fluid volume or blood volume or ionic concentration of blood



Activate hypothalamus to secrete (ADH) → Antidiuretic Hormone or Vasopressin hormone.



ADH hormone act on later part of tubule & collecting tubule to absorb water.



Prevent diuresis (more urine)

### → other functions of ADH

ADH also stimulate renal Cortex of renal gland to secrete mineralocorticoids or Aldosterone hormone.



Aldosterone causes the absorption of sodium from the distal part of tubule.



ADH also act as Vasoconstrictor means Contract the blood vessels / Capillary



i.e. ↑ the Blood Pressure



Hence, GFR becomes maintain

## → Micturition or, Voiding

- \* release of urine from urinary bladder
- Urine store in urinary bladder

↓  
stretch the receptor of bladder

↓  
Pass the signal into Central Nervous System through sensory or afferent neuron.

↓  
In terms CNS pass signal to the urinary bladder muscle through motor or efferent neuron.

↓  
bladder Contract & release the urine

- \* Urine Composition & Urine amount.

Human excrete 1.5 to 2 litre urine per day.

## → Composition

- light yellow colour watery fluid  
(yellow colour due to urochrome pigment formed by breakdown of Hb)
- contain or excrete 25 to 35 g urea in a day.
- Various ions like sodium etc.

## → Glycosuria

- ↳ presence of glucose in urine, due to diabetes mellitus (Sugar ki bimari).

## → Hematuria

- ↳ Presence of blood in urine

## → Uremia

- ↳ accumulation of urea in blood due to malfunctioning of the kidney.

"Uremia correct by Haemodialysis or Artificial kidney"

→ Artificial kidney or Haemodialysis.

↳ blood of patient taken from the body through artery & transport into Dialysing unit.

→ Dialysing unit

↳ have an dialysing fluid (same composition of Plasma) and also use a porous cellophane membrane

⇓

blood pass into cellophane membrane have more amount of urea comes out into dialysing fluid by diffusion.

→ blood are purified and pass to patient through Conventional vein.

→ Disease

Renal Calculi : insoluble mass of crystallised salts (oxalates, etc) are formed within the kidney.

Glomerulonephritis : inflammation glomeruli of kidney.

NOTE :

RAAS : Renin angiotensinogen Aldosterone system;

↳ renin angiotensinogen → BP → In kidney → GFR

Aldosterone system :-  $\text{Na}^+$ ,  $\text{H}_2\text{O}$  absorbed from distal part of tubule.

ANF - Atrial Natriuretic Factor

↳ Cause Vasodilation

↳ ∴ ↓ BP.

# Locomotion and Movement

- All locomotion is kind of movement.
- These movement result in change of place or body posture, such movement called locomotion.
- All locomotion are movement but all movement are not locomotion.
- Locomotion is a character of animal.  
Movement is a character of Plant.
- Locomotion is due to co-ordination b/w skeleton system, muscular system and Nervous system.

eg: Amoeba → Protoplasmic streaming

↓  
develop pseudopodia (false feet)

help in locomotion

Paramoecium  $\rightarrow$  have cilia  
(Cause bar like movement)

help in locomotion

movement of food  
through cytopharynx.

Hydra  $\rightarrow$  have tentacles  $\left[ \begin{array}{l} \text{help in locomotion} \\ \text{capturing of prey} \end{array} \right.$

→ Human body cell exhibit different types movement.

① Amoeboid movement

shown by  $\left[ \begin{array}{l} \rightarrow \text{macrophages cells or phagocytic cell.} \\ \rightarrow \text{leucocyte cell or WBCs.} \end{array} \right.$

Eg:- Monocyte and neutrophils are phagocytic cells they may be move in opposite dir'n of blood with the help of amoeboid (*Pseudopodia*).

## NOTE:

Cytoskeleton or microfilaments of cell also show amoeboid movement.

### II) Ciliary Movement

shown by → Trachea (wind pipe) cause the movement mucus.

→ Muscle → Fallopian tube (oviduct) cause the movement of ova in genital tract.

→ muscular mov. shown by muscle

→ 40 to 50% body weight contribute by muscle

→ Property muscle → excitability, contractility, extensibility, elasticity.

### III) Muscular movement

On the basis of location mainly, structure & function, muscles are of three types:-

- i) skeleton muscle
- ii) smooth muscle
- iii) Cardiac muscle

#### \* Skeleton Muscle

- closely associated with skeletal system
- striated
- voluntary
- multinucleate
- help in locomotion, writing and facial expression

#### \* Smooth Muscle

- uninucleated
- found in hollow body organ or internal body organ.
- eg; alimentary canal → intestine, stomach etc.  
urinary bladder

Constricted or not striated; involuntary

do not under conscious mind

## Cardiac muscle

- found in heart wall (myocardium)
- striated (just like skeletal muscle)
- Involuntary (just like smooth muscle)
- Usually uninucleated (one nucleus in cell)
- all are branched & interconnected (having bridge)
- Contractions are rhythmic and automatic (myogenic heart - current originate from muscle).
- Intercalated disc are present in some places or location (join the cells for synchronized contraction).
- Do not get fatigued easily.

