

Urinary System

[DEPTH OF BIOLOGY]

workhouse

Kidney

[DEPTH OF BIOLOGY]

Physical

Features

and

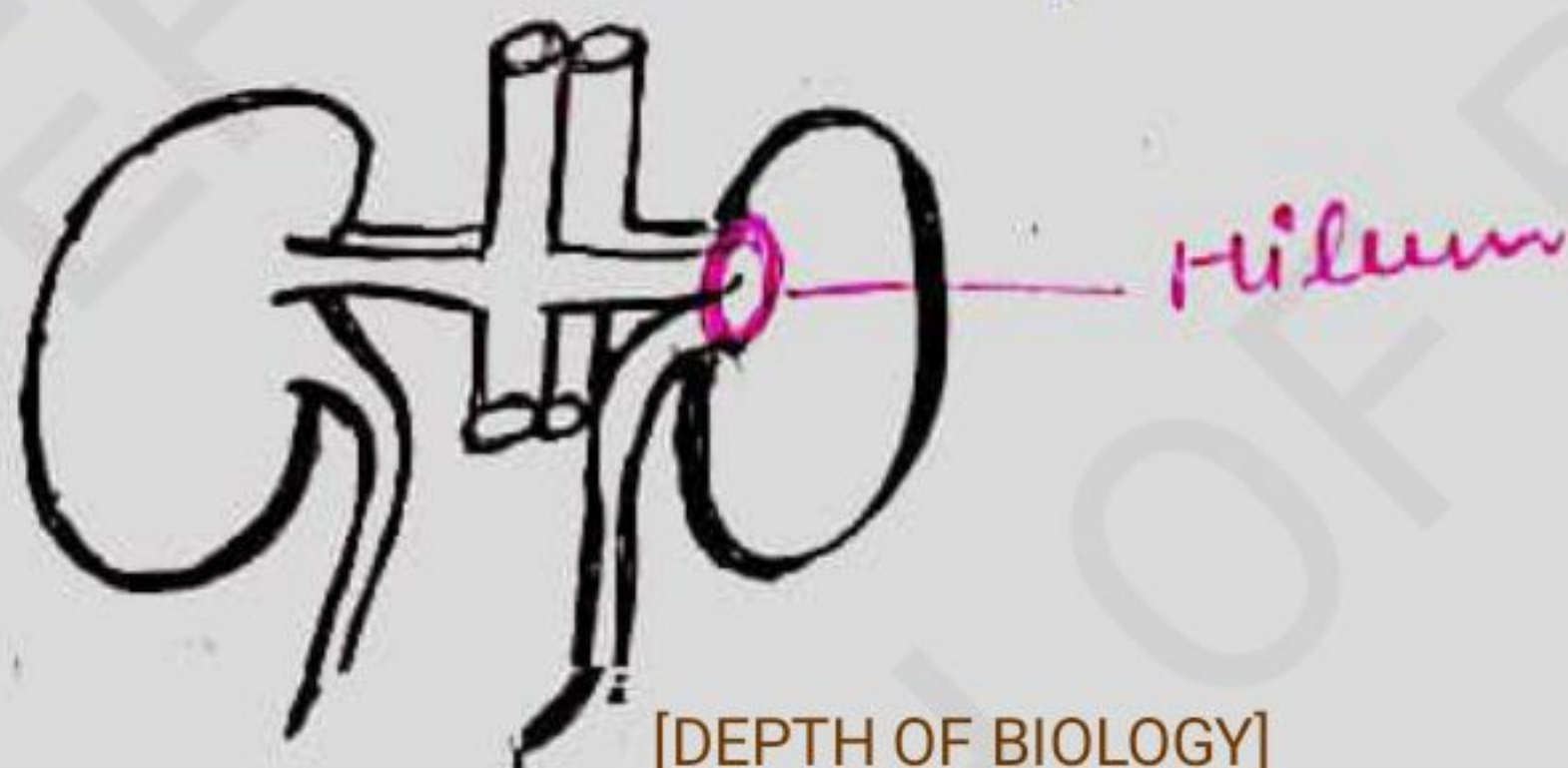
Location

of

Kidneys

- wt. 150g
- size - 10-12 cm long
- reddish colour
- located between T₁₂ and T₁₃ vertebrae partially protected by floating ribs (11 and 12)
- sits behind the peritoneal memb. alongside the vertebral column.
- each kidney contains 2.2 million nephrons [DEPTH OF BIOLOGY]
- The right kidney is pushed down liver so it sits slightly lower than the left kidney.
- The middle of each kidney there is an indentation that forms renal hilum.

* Hilum is the entry and exit point for the ureters, renal artery, renal veins, lymphatic and nerves goes into and comes out of the kidney.



[DEPTH OF BIOLOGY]

* why is kidney called as the warehouse of the urinary system? [DEPTH OF BIOLOGY]

- It clears the harmful subs. by filtering the blood.
- It regulates blood pH, volume, pressure, osmolarity as well as production.

* kidney is surrounded by 3 layers of tissue [DEPTH OF BIOLOGY]

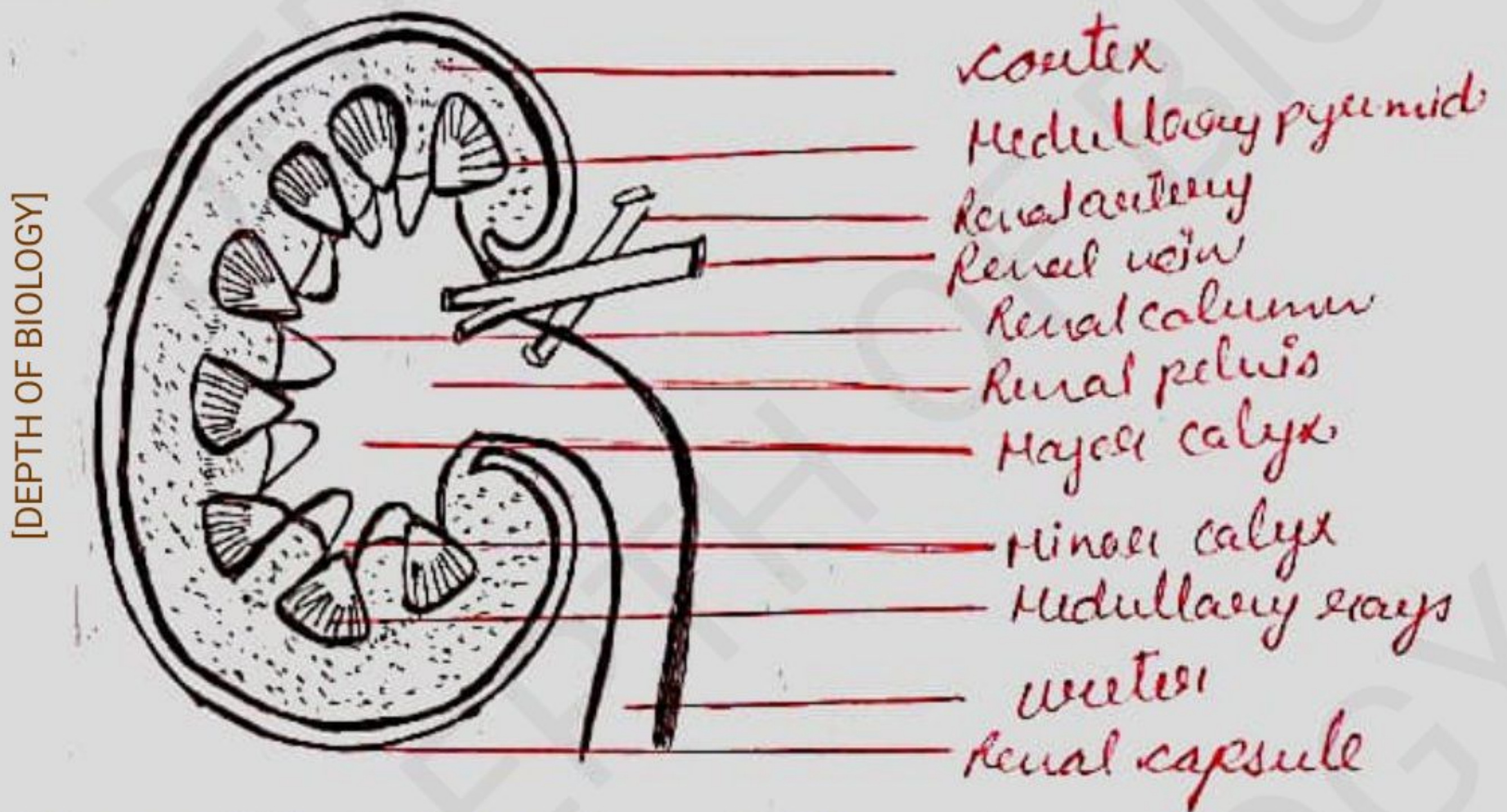
Renal Fascia → outermost layer

Adipose capsule → middle layer.

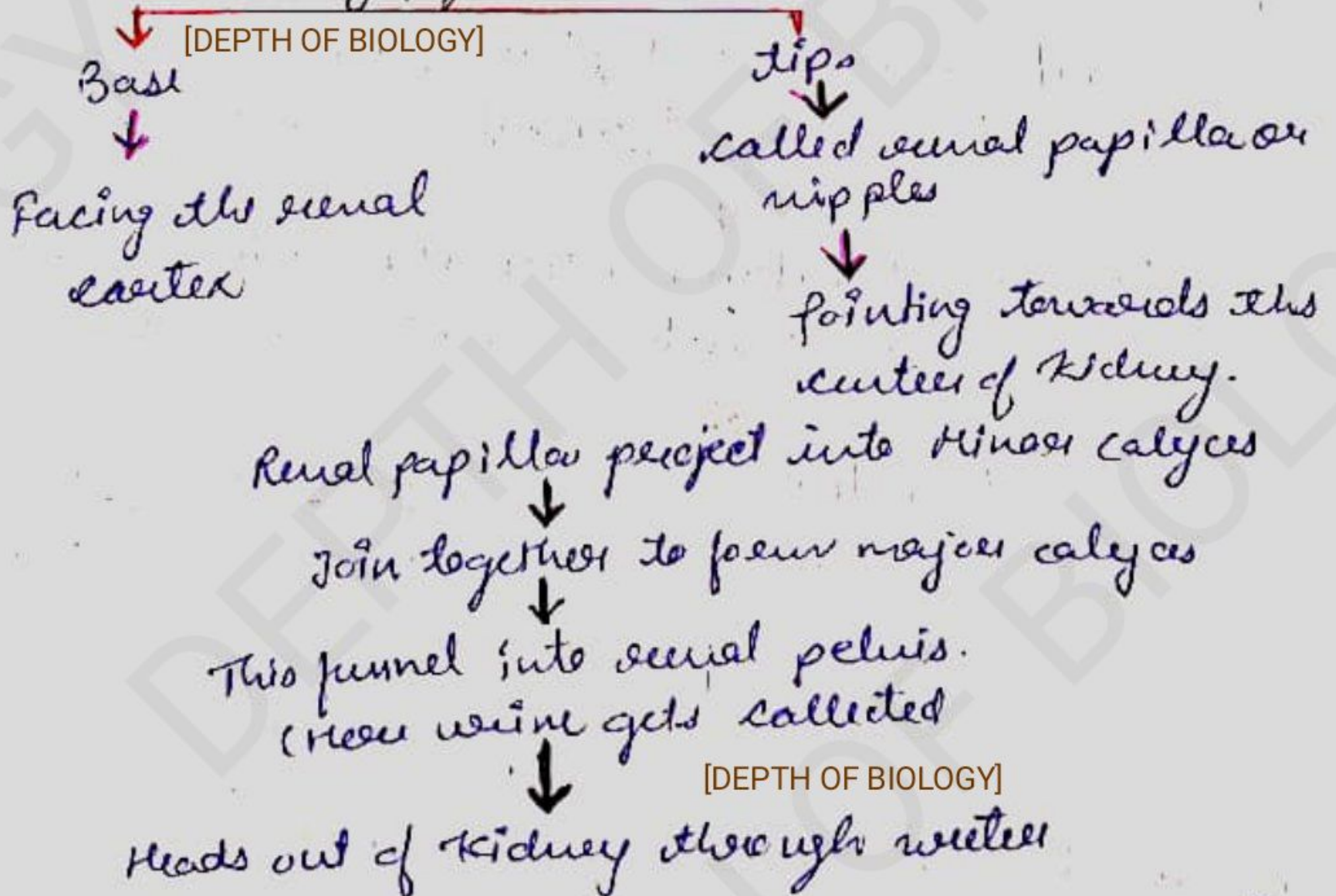
Renal capsule → innermost layer.

- Renal fascia → thin layer of dense c. tissue [DEPTH OF BIOLOGY]
↓
anchors the kidney to its surroundings.
- Adipose capsule → fatty layer
↓
protects kidney from trauma [DEPTH OF BIOLOGY]
- Renal capsule → smooth transparent sheet of dense connective tissue.

cross section of kidney :-



- Inner portion of renal medulla and outside rim is the renal cortex.
- Medulla region is made up of 10-18 renal pyramids or medullary pyramids.



• Renal cortex can be divided into

outer cortical zone

Inner juxtamedullary zone.

Anatomy of kidney [DEPTH OF BIOLOGY]

• section of Renal cortex $\xrightarrow{\text{called}}$ Renal Column
 \downarrow
extend down into medulla
 \downarrow
separate renal pyramid from each other.

* Each Renal Pyramid and the renal cortex above it's called a renal lobe.

Physiology of kidney [DEPTH OF BIOLOGY]

Adult kidney \rightarrow Filter 150 litre of blood everyday

To reach kidney blood flows from aorta into left and right renal arteries.

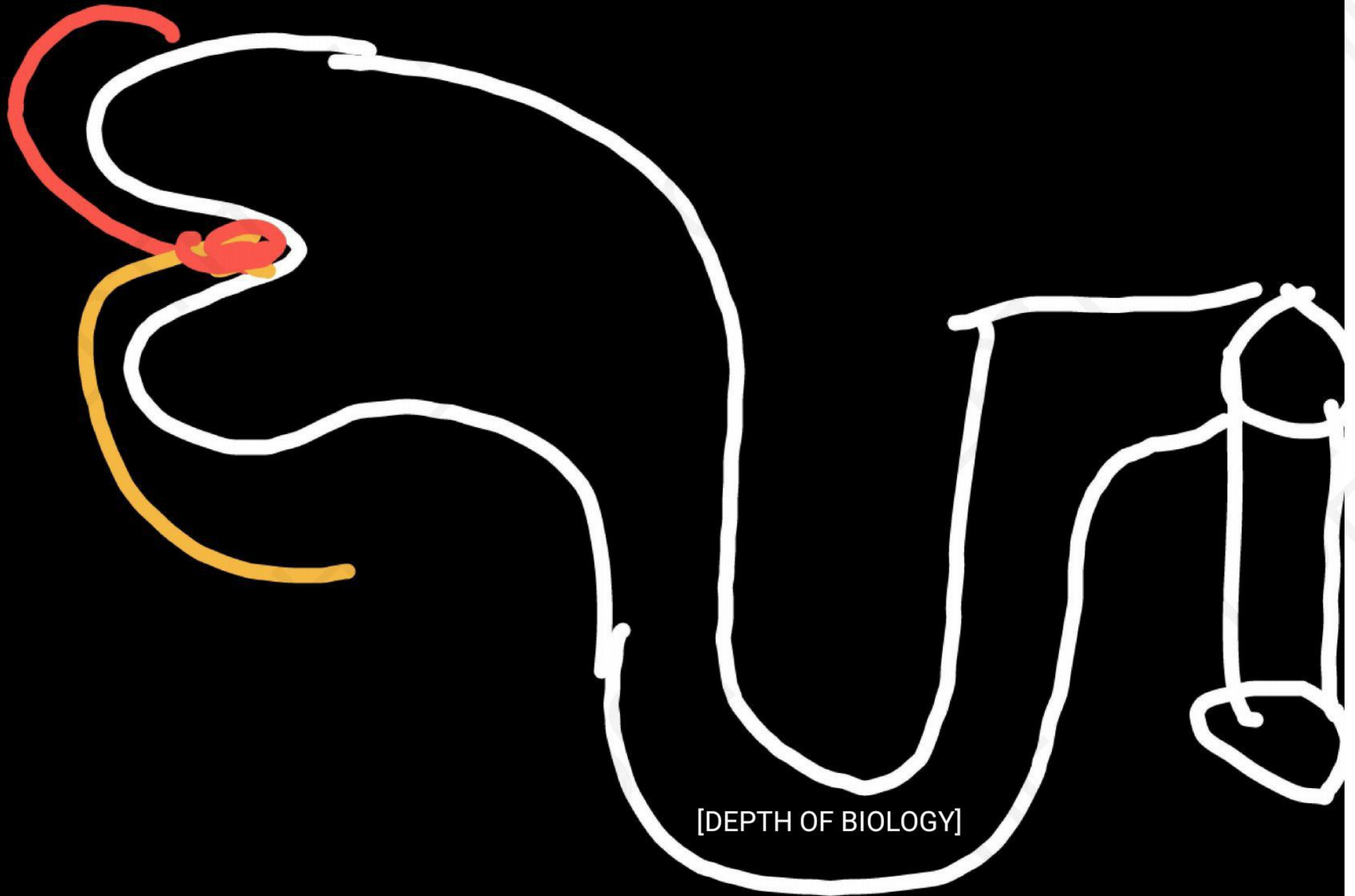
\downarrow
when renal arteries enter the kidney they get divided into segmental arteries

\downarrow
Then into interlobal arteries pass through the renal column then to arcuate arteries that govern the

\downarrow
Bases of renal pyramids

[DEPTH OF BIOLOGY]

* Cortical radiate artery which supply the cortex



[DEPTH OF BIOLOGY]

continue to divide eventually forming afferent arterioles



that split into tiny bundles of capillaries called the glomerulus.

• Diameter of afferent arteriole is more than efferent arteriole



Increases pressure



Filtration increases.

glomerulus :- site where blood filtration starts. This is 50 times more permeable than capillaries.

Once the blood leaves from this glomeruli does not enter into venules. [DEPTH OF BIOLOGY]

* These peritubular capillaries then unite to become the cortical radiate veins.



Then the arcuate veins → then to Interlobar veins

and then finally into the left and right renal veins



which connects to the I.V.C.

FLOW OF ARTERY

* flow of veins are equal to or similar to the out in reverse.

The only diff. is there is a segmental artery but no such segmental vein. [DEPTH OF BIOLOGY]

* Each kidney has about million of Nephrons

[DEPTH OF BIOLOGY]

↓
Each nephron is made up of renal capsule and renal tubule.

Renal capsule → where blood filtration starts

• Includes Glomerulus → tiny bed of capillaries.

* 3 components of nephron responsible for filtration

→ ① Glomerular capillaries.

→ ② Basement membrane

→ ③ Visceral epithelial cells of Bowman's capsule.

• Solutes in urine — urea, creatinine, uric acid, urobilinogen

urine → 95% H₂O + 5% is derived from cellular metabolism and outside source.

Urine product → G.F + T₈ + T.S

• Bowman's capsule → surrounds the glomerulus (made up of renal cells). [DEPTH OF BIOLOGY]

Now,
As blood flows into the → glomerulus

• H₂O and some solute in blood like Na⁺, are able to pass through the endothelium lining of the capillary.

↓
Holes across the basement membrane. (6-7 nm)

↓ [DEPTH OF BIOLOGY]

↓
Through the epithelial lining of Nephron and finally into the Bowman's space of the Nephron itself at which point it is called filtrate. [DEPTH OF BIOLOGY]

The epithelium of Nephron is made up of specialized cells called Podocytes.

↓
which wrap around the basement memb. like the tentacles of an octopus.

↓
Between these tentacles - like projection are tiny gaps called filtration slits that act like a sieve allowing only small particles such as H_2O , glucose and Ionic salts to pass through while blocking large protein and RBC. [DEPTH OF BIOLOGY]

• Vasa recta →

Near loop of Henle, afferent arteriole divides into blood capillaries forms network of capillaries.

Cortex has → B.C + PCT + DCT → C. Duct
Medulla ← [DEPTH OF BIOLOGY]

As the filtrate leaves the Bowman's capsule

↓
It flows into renal tubule, which is surrounded by peritubular capillaries.

↓
Renal tubule itself can be divided into PCT, Nephron

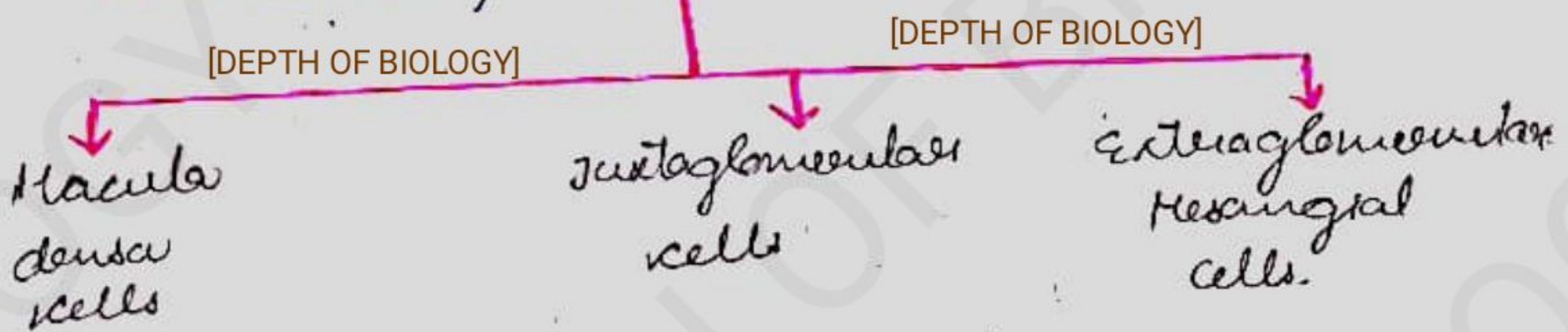
loop or loop of Henle which is made up of descending limb and ascending limb, the DCT and finally the collecting duct which ultimately send the urine to the minor Calyx. [DEPTH OF BIOLOGY]

JG Apparatus (Juxtaglomerular apparatus)

Each nephron also has a really unique region called the Juxtaglomerular complex which is involved in the regulation of BP and GFR. It is the amount of blood that passes through the glomeruli each minute.

→ J.G. complex located between DCT and afferent arteriole

There are 3 types of JG complex.



Extraglomerular Mesangial cells.

located in DCT

sens when the level of Na, Cl is low.

sends signal to JG cells located in walls of afferent arterioles.

The extraglomerular Mesangial cells help with the signalling between Macula densa cells and J.G cells [DEPTH OF BIOLOGY]



The J.G cells then detect the signal and also independently sense the low pressure in vessels and secrete Renin enzyme



which ↑ res sodium (Na) reabsorption helps in raising blood volume

Renin also causes constriction of blood vessel which increases the blood pressure. [DEPTH OF BIOLOGY]

Millions of nephrons, each makes urine



It flows into minor calyces.



Then Major calyces.



Finally into Renal pelvis.



[DEPTH OF BIOLOGY]

goes down ureter (has muscular lining which help into pushing the urine



gets filled up in the bladder at a sideways angle
(Uterovesical Jn.)



so that when the bladder becomes full it compresses the opening to the ureter preventing backflow. 9

- Basically it is one way valve that prevents urine \rightarrow from refluxing backward from bladder into the ureters.

- Bladder (Urinary Bladder.) [DEPTH OF BIOLOGY]

The bladder itself is like a balloon.

Its muscular wall has many folds called rugae that contract when the bladder is emptied of urine and expand when it's filled with urine.

\rightarrow In the layers of the bladder wall are a mucosa layer that has a transitional epithelium, which is stretchy allowing for bladder distention while maintaining a barrier b/w urine and body.

[DEPTH OF BIOLOGY]

- There is a thick muscular layer called detrusor muscle that helps with bladder contraction during micturition and it has fibrous adventitia outer layer.

\rightarrow In women the bladder is in front of vagina, uterus and rectum.

\rightarrow In Males bladder is just in front of rectum

- On average bladder can hold around 750 ml urine or one wine bottle. [DEPTH OF BIOLOGY]

\rightarrow Slightly less in women because of space held by the uterus that's especially true during pregnancy.