



**SNS COLLEGE OF ALLIED HEALTH SCIENCES**  
SNS Kalvi Nagar, Coimbatore - 35  
Affiliated to Dr MGR Medical University, Chennai



**DEPARTMENT: ALLIED HEALTH SCIENCES**  
**COURSE NAME: ANATOMY**

**Unit: Anatomy of Kidney**

**Topics: Features of Kidney, Nephron, Blood  
Supply, Juxtaglomerular Apparatus**

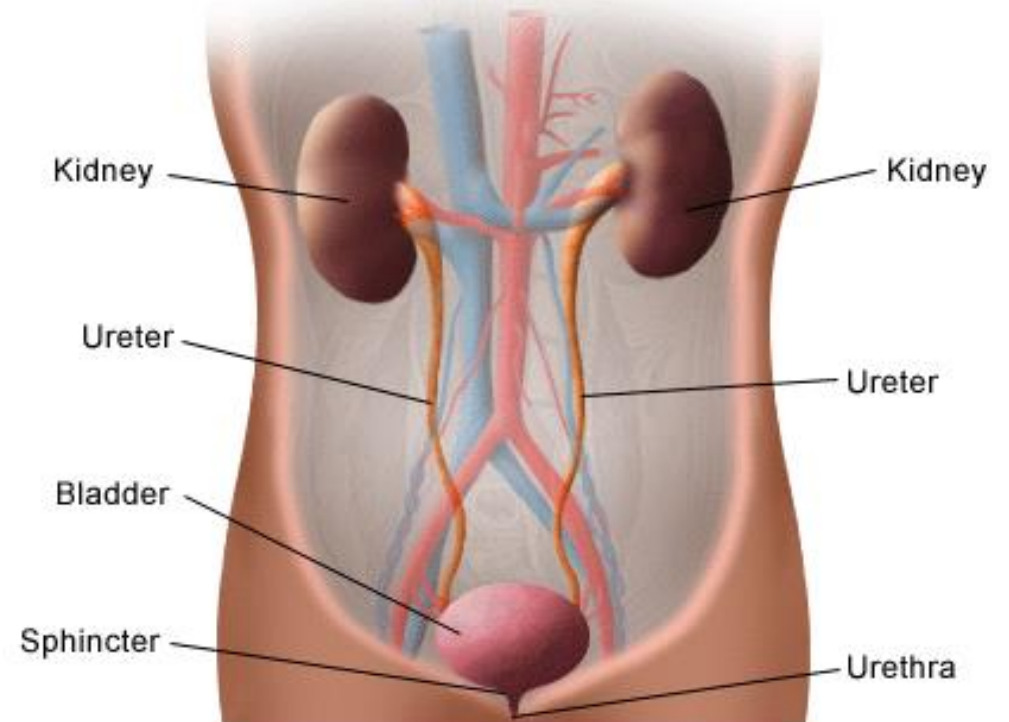


## LOCATION



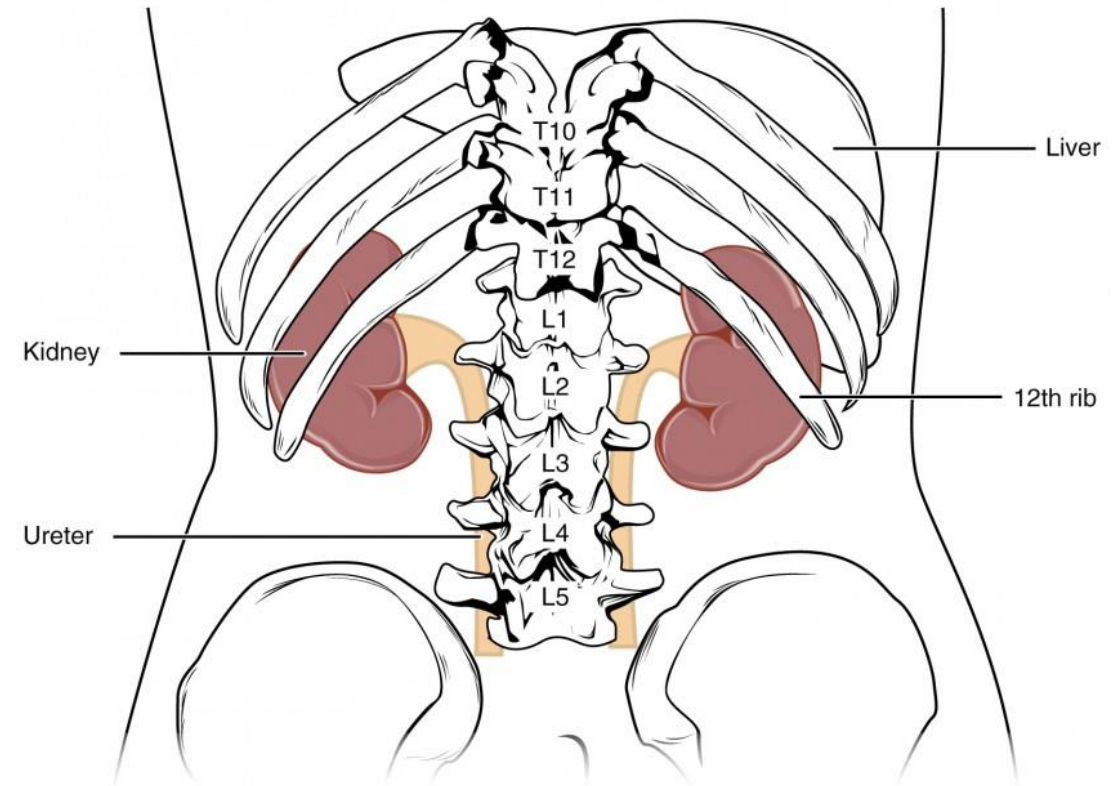
- **Renal** = pertaining to the *kidneys*
- **Renal System Parts:** *A pair of kidney, Ureters, Urinary bladder and Urethra*
- **Location:** *Located in the abdominal cavity on either side of the spine in a retroperitoneal position.*
- **Approx. at vertebral level T12 to L3**

Front View of Urinary Tract



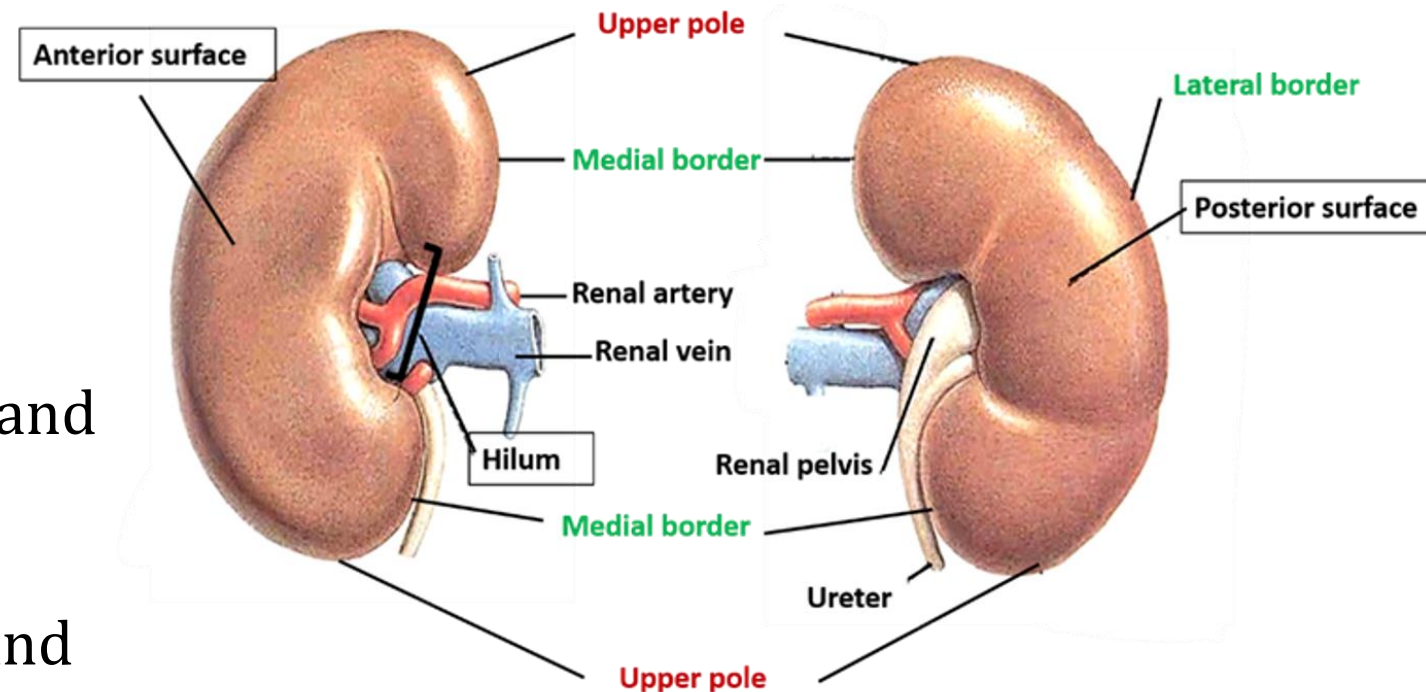
## LOCATION

- **Right kidney being slightly lower** than the left
- Left kidney is little nearer to median plan than right.
- Kidneys are **mobile organs** that move vertically within the retroperitoneum on average of 0.9cm to 1.3cm and as much as 4cm during normal respiration.
- Kidney is made up of closely arranged tubular structures called **uriniferous tubules**.



# KIDNEY EXTERNAL FEATURES

- **Shape:** Bean Shaped
- **Poles:** Upper and Lower
- **Border:** Medial and Lateral
- **Surface:** Anterior and Posterior
- **Size:** Approx. 11 – 14cm in length and 6cm wide and 3cm thickness
- **Weight:** Around 150gm in males and 135gm in females



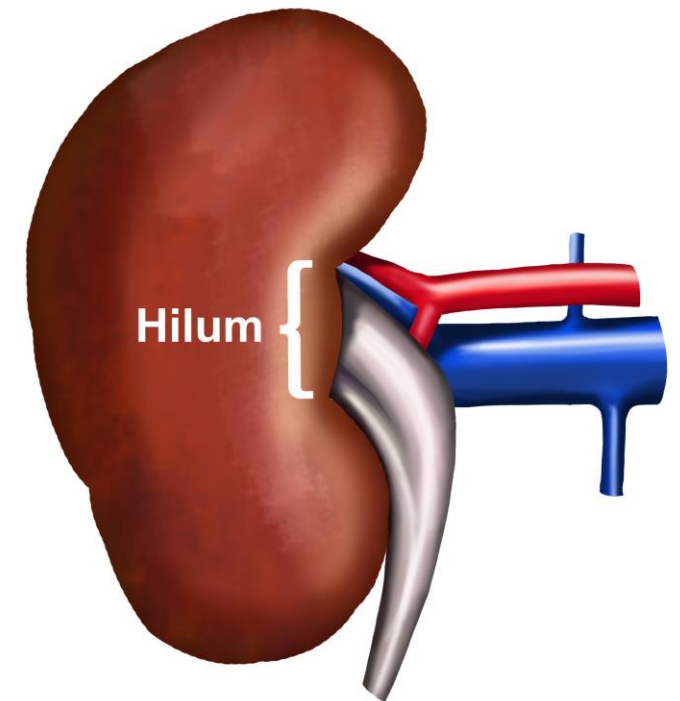


# EXTERNAL FEATURES



## Hilum of the Kidney

- Concave medial border of the kidney
- Structures enter / leave through the hilum (from anterior to posterior)
- The structures are ***Renal Vein, Renal Artery, Pelvis, Ureter, Renal Nerves and Lymphatics***





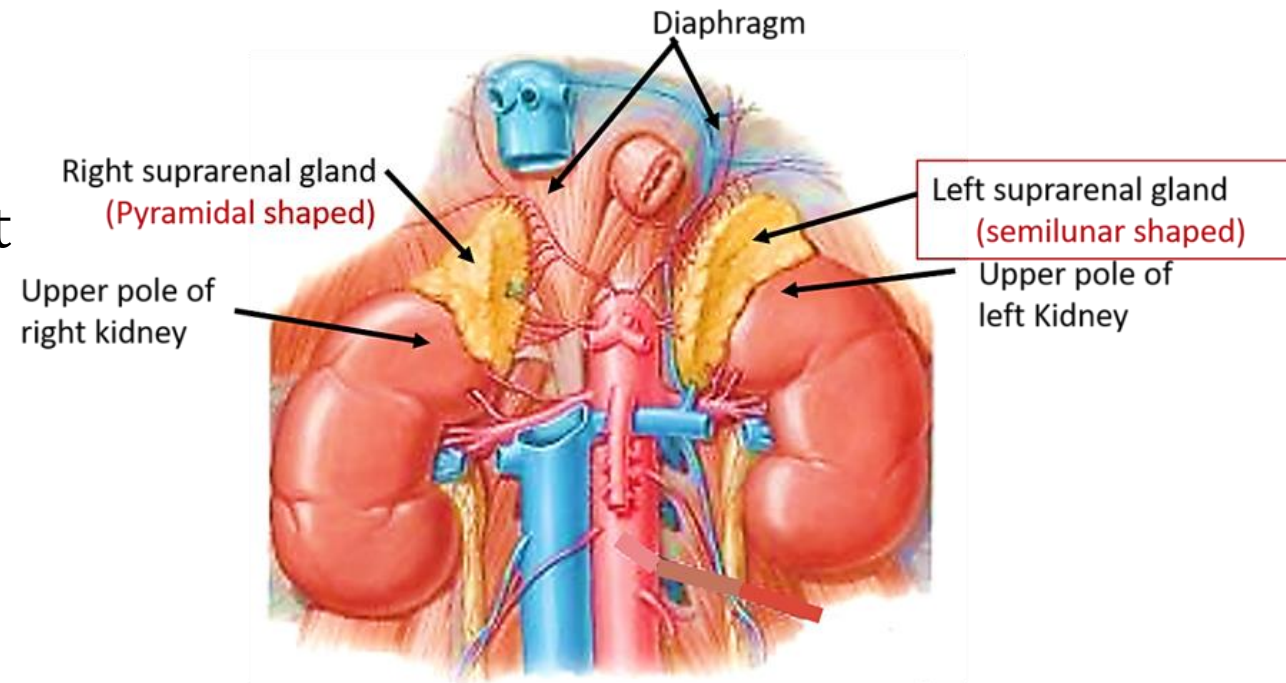
## ASSESSMENT – I



- Shape of the Kidney -----
- Location of the Kidney -----
- Right kidney being slightly lower than the left why?
- Concave medial border of the kidney is called -----

# RELATIONS OF KIDNEY

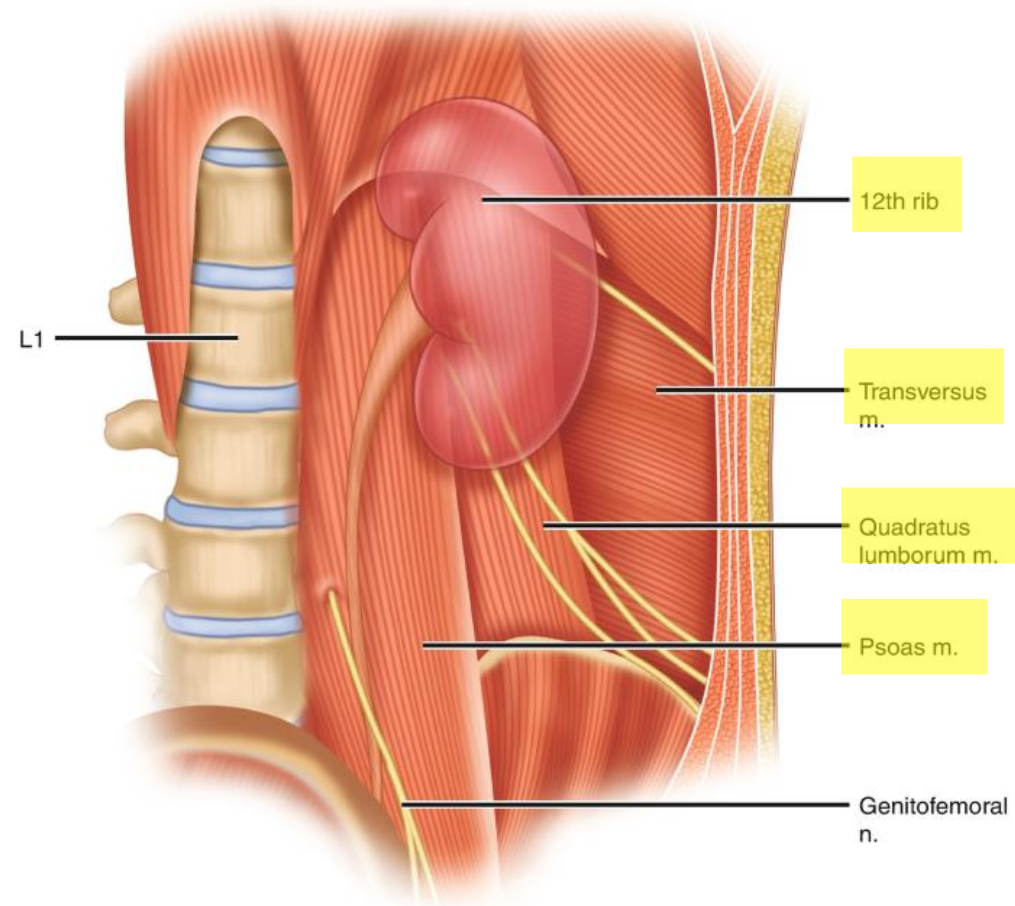
- **Upper Pole:** Adrenal Gland
- **Lower Pole:** About 2.5cm above iliac crest
- **Posterior Relations:**  
**Diaphragm**



## Posterior Relations:

**Muscles:** Psoas major, Quadratus Lumborum, Transverse Abdominis

**Ribs:** 11<sup>th</sup> and 12<sup>th</sup> ribs on left, only 12<sup>th</sup> on right





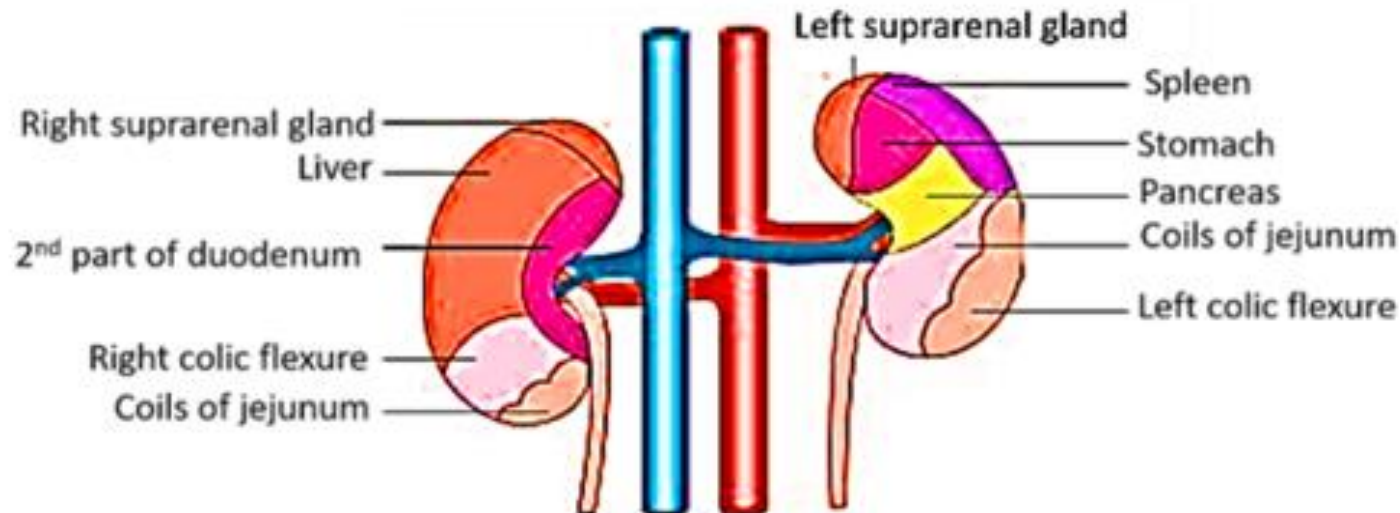
# ANTERIOR RELATIONS

## Right kidney

- Right suprarenal gland
- Right lobe of liver
- 2<sup>nd</sup> part of duodenum
- Right colic flexure
- Coils of jejunum

## Left kidney

- Left suprarenal gland
- Stomach
- Spleen
- Pancreas
- Left colic flexure
- Coils of jejunum



# POSTERIOR RELATIONS

## Left kidney:

Diaphragm

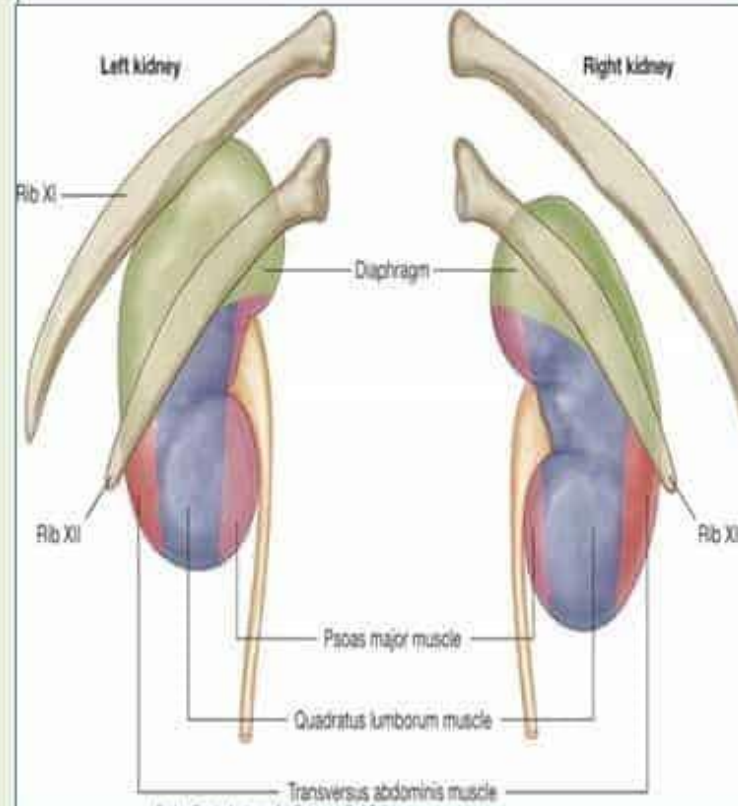
Costodiaphragmatic recess of the pleura

**11<sup>th</sup> & 12<sup>th</sup> ribs; last intercostal space**

Psoas major

Quadratus lumborum  
transversus abdominis.

Subcostal (T12),  
iliohypogastric &  
ilioinguinal nerves.



POSTERIOR RELATIONS

## Right kidney:

- Diaphragm

- Costodiaphragmatic recess, of the pleura

- **12<sup>th</sup> rib, last intercostal space**

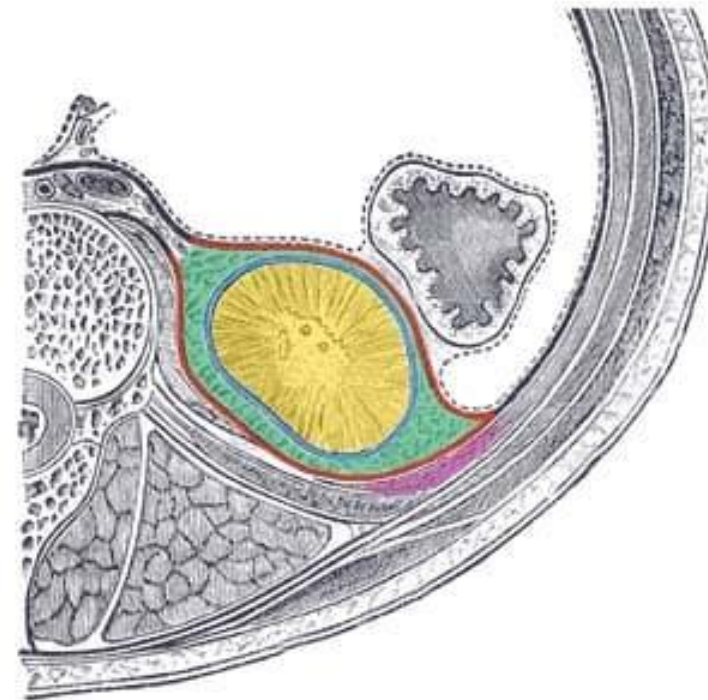
- Psoas major

- Quadratus lumborum,  
transversus abdominis.

- Subcostal (T12),  
iliohypogastric &  
ilioinguinal nerves.

## COVERINGS OF KIDNEY

- **Fibrous Capsule** – It surrounds the kidney
- **Perirenal Fat** – it covers fibrous capsule
- **Renal Fascia** – it is a condensation of connective tissue that encloses the kidneys and suprarenal glands
- **Pararenal Fat** – it lies external to the renal fascia and forms a part of the retroperitoneal fat





## ASSESSMENT – II



- What is present in the upper pole of Kidney?
- What are the muscle relations of kidney?
- Pancreas impression is seen on which side of the kidney?
- What covers fibrous capsule ?

# CORONAL SECTION OF KIDNEY

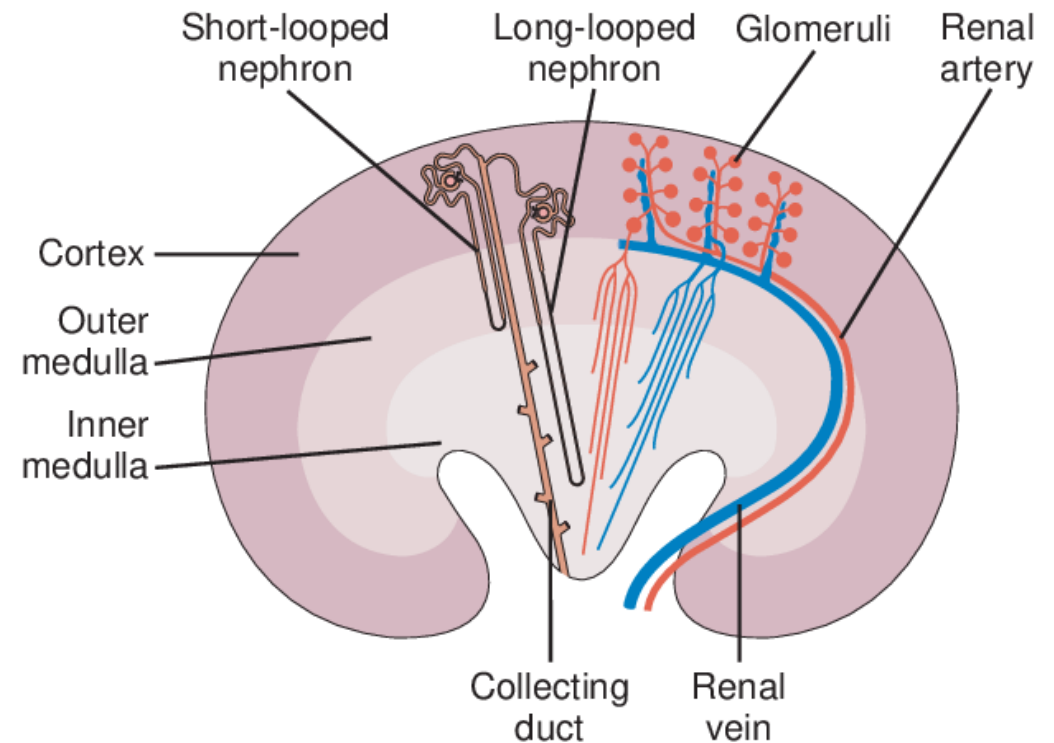
## RENAL CORTEX

- It is the outer part of the kidney
- Located just below the capsule
- Bowman's capsules and Glomeruli, PCT and DCT are located in this part.

## RENAL MEDULLA

- It is the inner part of the kidney
- It has 10 – 12 dark colored pyramids
- The base is towards the cortex and apex (renal papilla) opens into minor calyx

## Coronal Section Through a Unipapillary Kidney



**Fig. 1.1** Coronal section through a unipapillary kidney.

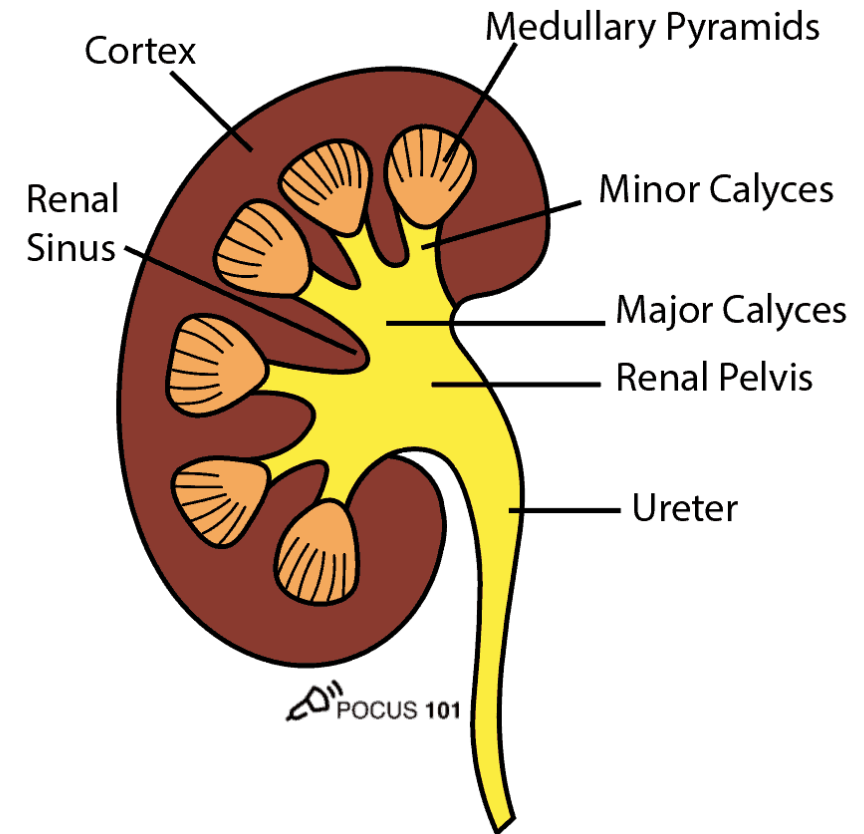
# CORONAL SECTION OF KIDNEY

## RENAL SINUS:

It is a space between the renal parenchyma and hilum

It contains,

- **Minor Calyces**
- **Major Calyces**
- **Pelvis of Kidney**
- **Blood Vessels and Nerves**
- **Perinephric fat**

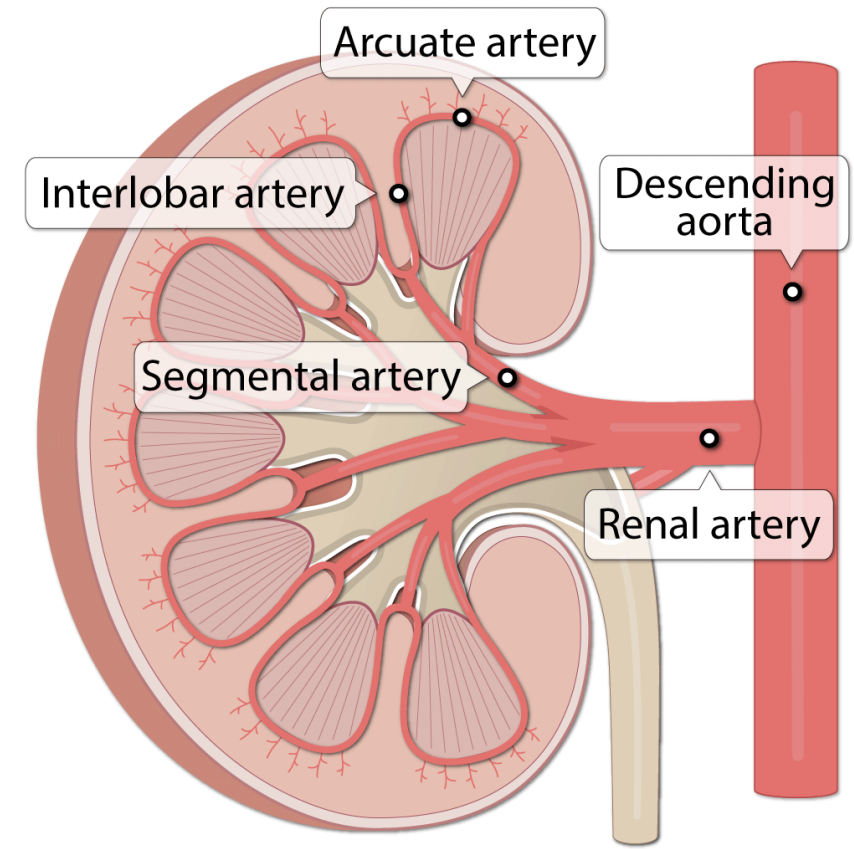




# ARTERIAL BLOOD SUPPLY

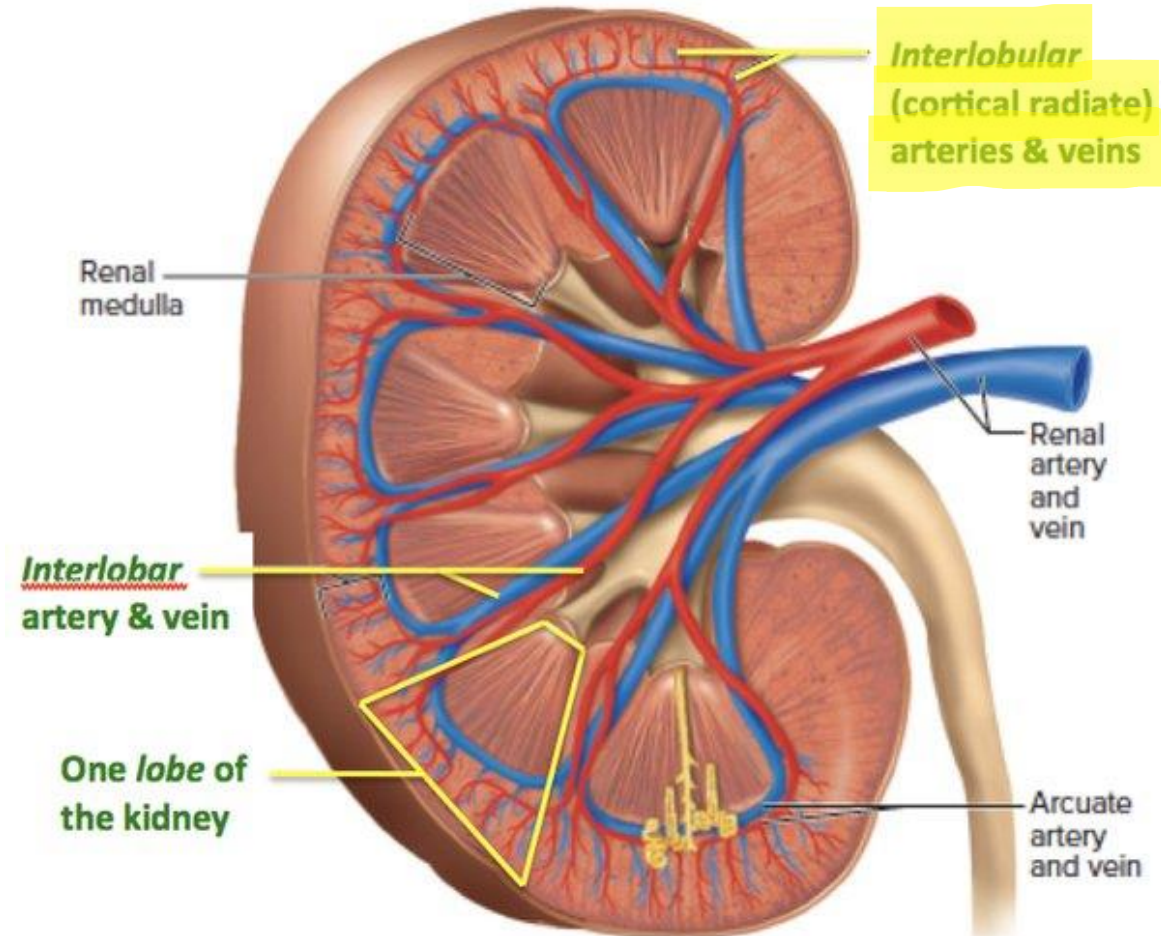


- Renal arteries arise from **abdominal aorta** at the level of intervertebral disc between L1 and L2.
- At hilum of the kidney the renal artery divides into **5 segmental branches**.
- In the renal sinus, the **segmental arteries** divide into **lobar arteries**, which further divide into **interlobar arteries**.
- Interlobar arteries pass between pyramids in the medulla.
- At the cortico-medullary junction, the each interlobar artery divides into **two arcuate arteries** (they do not anastomose with adjacent arcuate arteries).



# ARTERIAL BLOOD SUPPLY

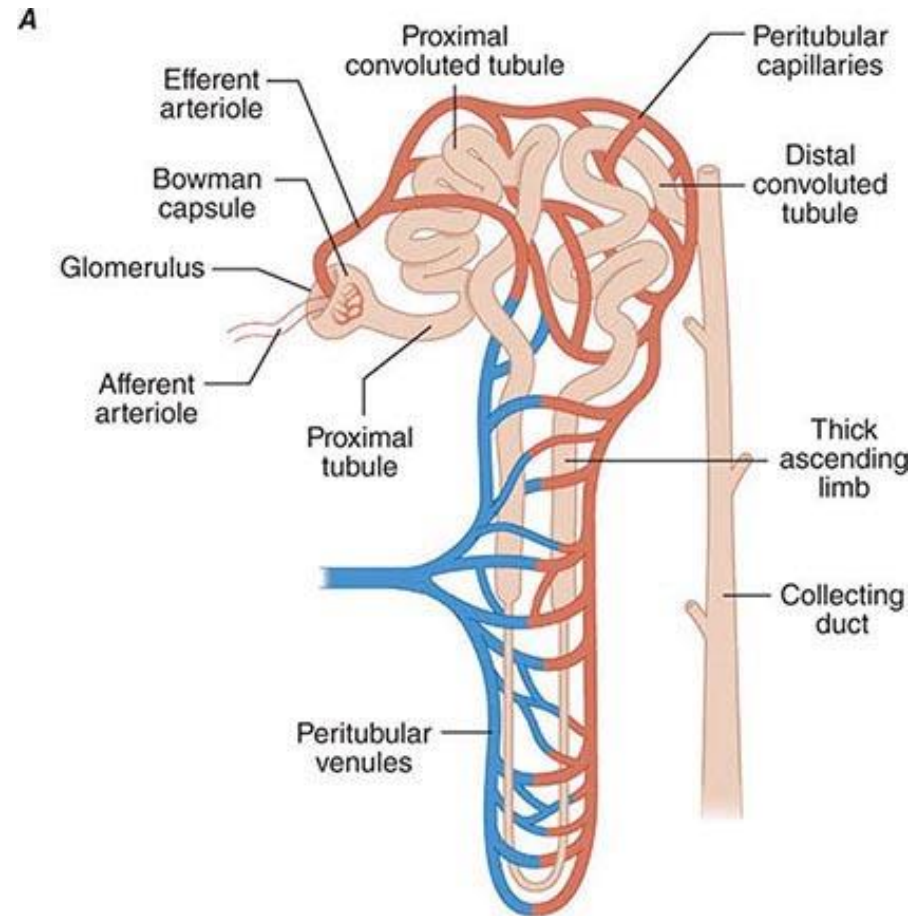
- From arcuate arteries arise **interlobular arteries** at right angle and pass through the cortex.
- Many **afferent arterioles** arise from interlobular artery which feed glomerular capillaries, which in turn end in **efferent arteriole**.
- Efferent arterioles breakup into **peritubular capillary plexus** around collecting tubules and ducts.





# VENOUS DRAINAGE

- Peritubular plexus drains into interlobular veins, which drain successively into arcuate, interlobular, interlobar, segmental and finally into renal veins.
- Renal veins drain into **inferior vena cava**.
- Left renal vein receives blood from left suprarenal and left gonadal veins.





## ASSESSMENT - III



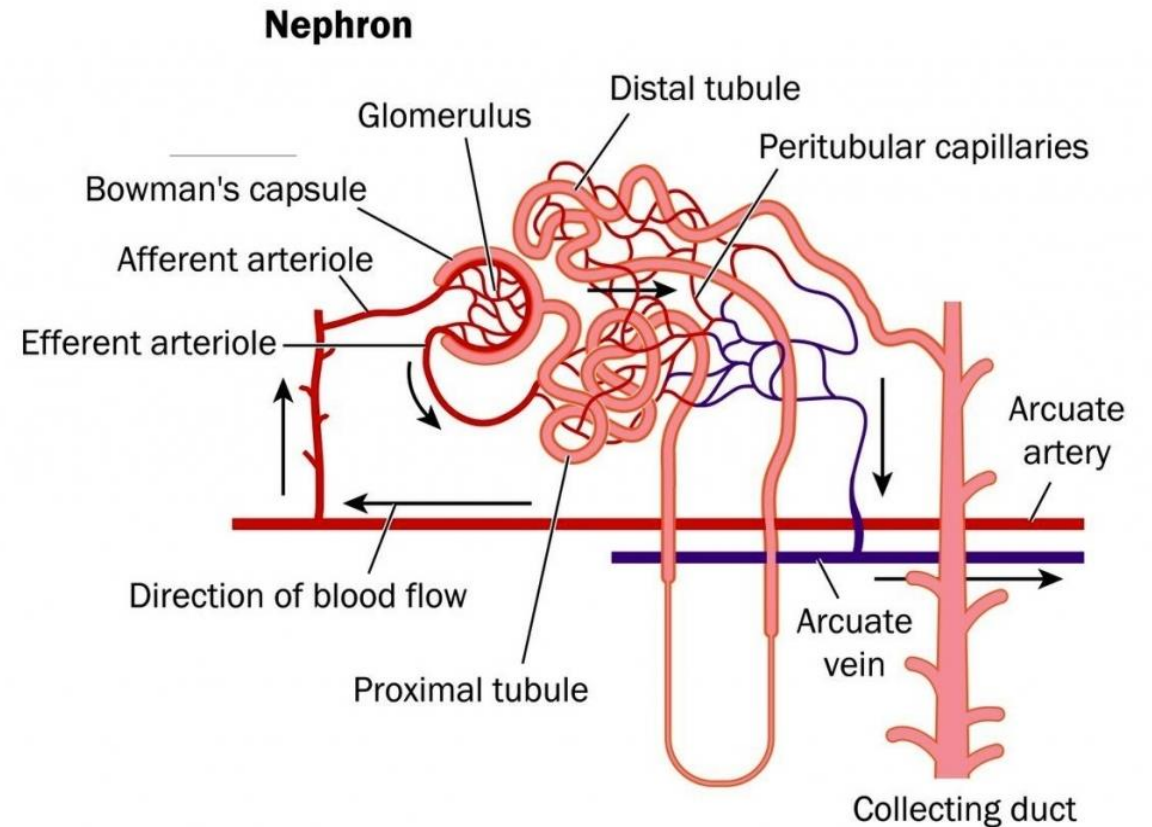
- What is the inner region of kidney is called -----
- Bowman's capsule is present in -----
- The space between renal hilum and parenchyma is called -----
- Segmental artery divides into -----
- Interlobular artery divides into -----

# NEPHRON

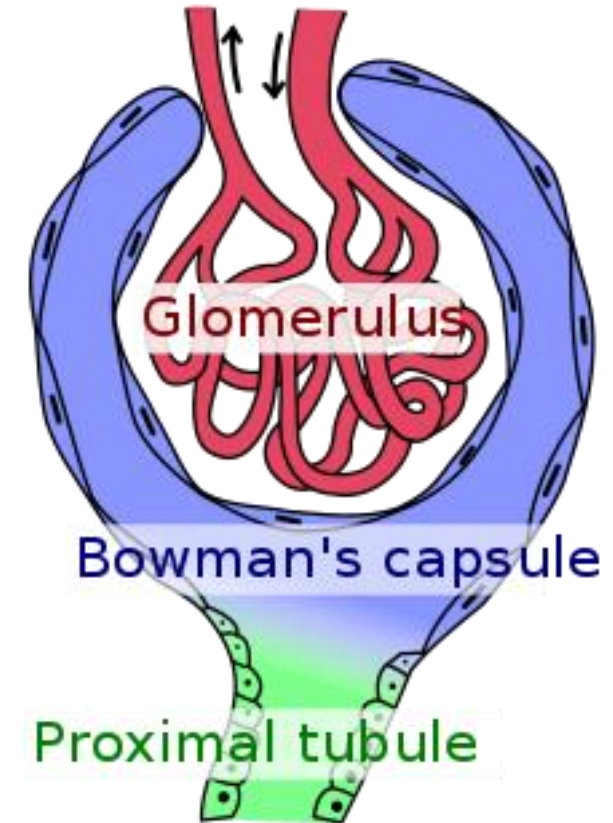
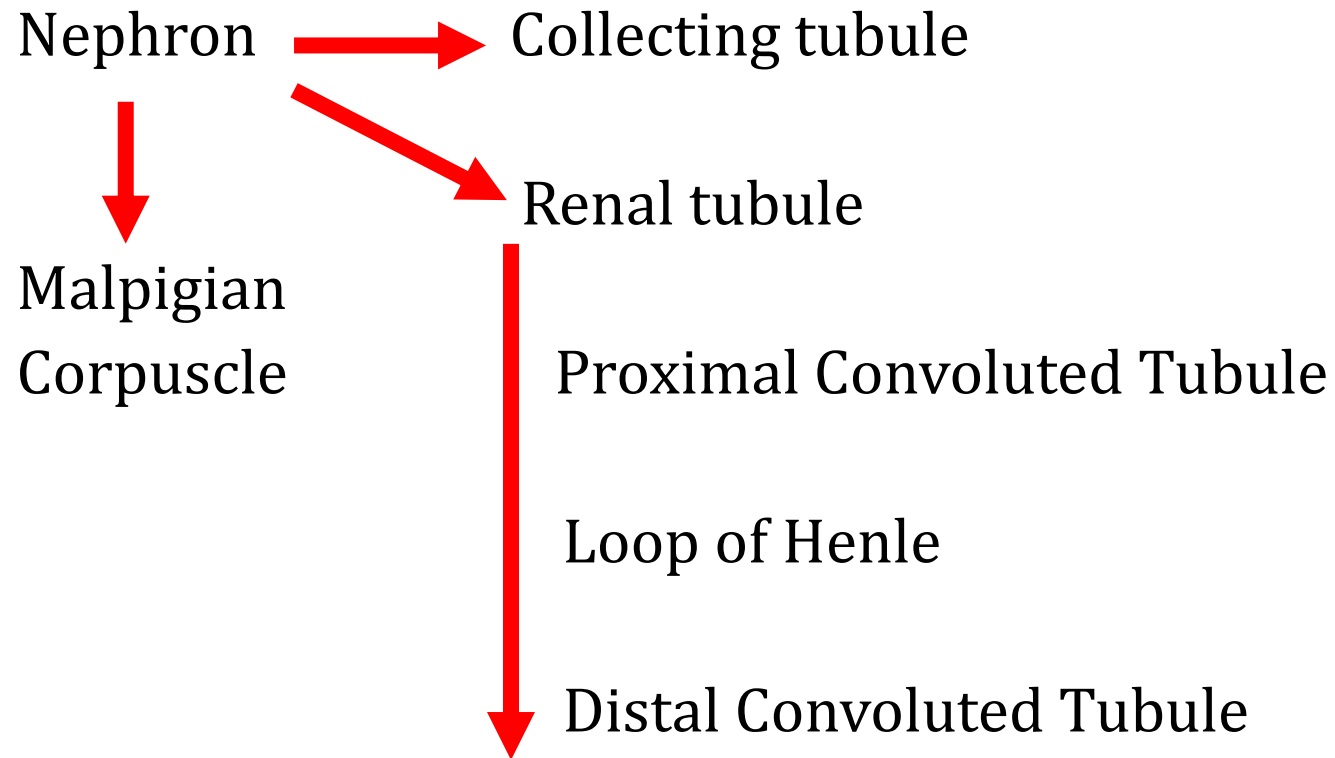
- ***Nephron*** is defined as the structural and functional unit of kidney.
- Each kidney consists of ***1 to 1.3 million*** of nephrons.

Each nephron is formed by two parts:

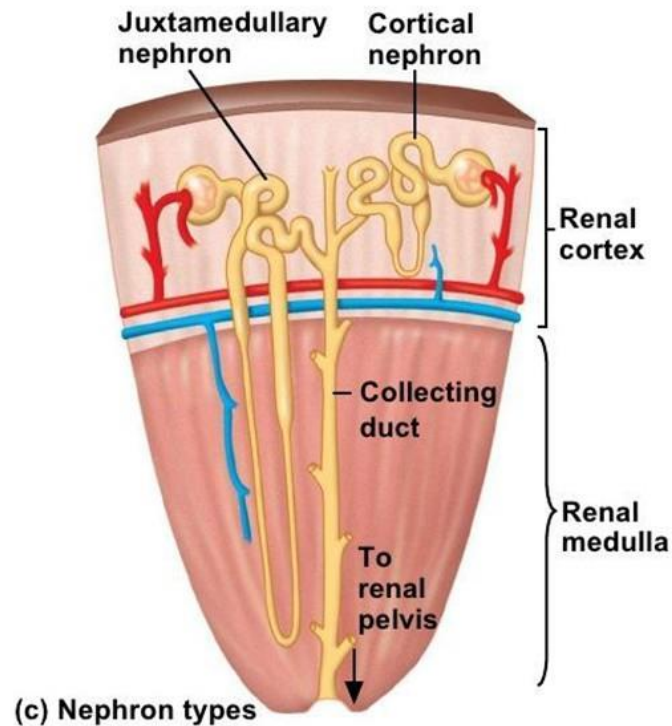
- A blind end called ***renal corpuscle or Malpighian corpuscle***.
- A tubular portion is called ***renal tubule***.



# NEPHRON STRUCTURE



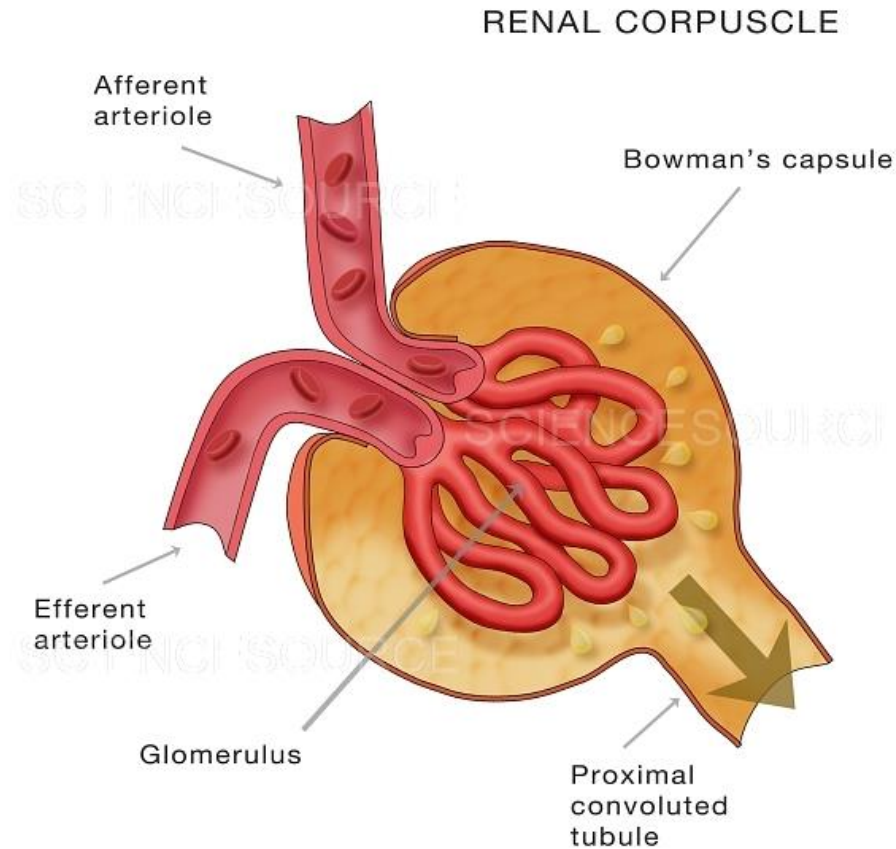
# CLASSIFICATION OF NEPHRON



FEATURES	CORTICAL JUNCTION	JUXTAMEDULLARY JUNCTION
Percentage	85%	15%
Situation of renal corpuscle	Outer cortex near the periphery	Inner cortex near the medulla
Loop of Henle	Short Hairpin bend penetrates only up to outer zone of medulla	Long Hairpin bend penetrates up to the tip of papilla
Blood supply to tubule	Peritubular capsules	Vasa recta
Function	Formation of urine ( excretion of waste product in urine )	Mainly the concentration of urine and also formation of urine
O <sub>2</sub> extraction	Very less	Large

# STRUCTURE OF RENAL CORPUSCLE

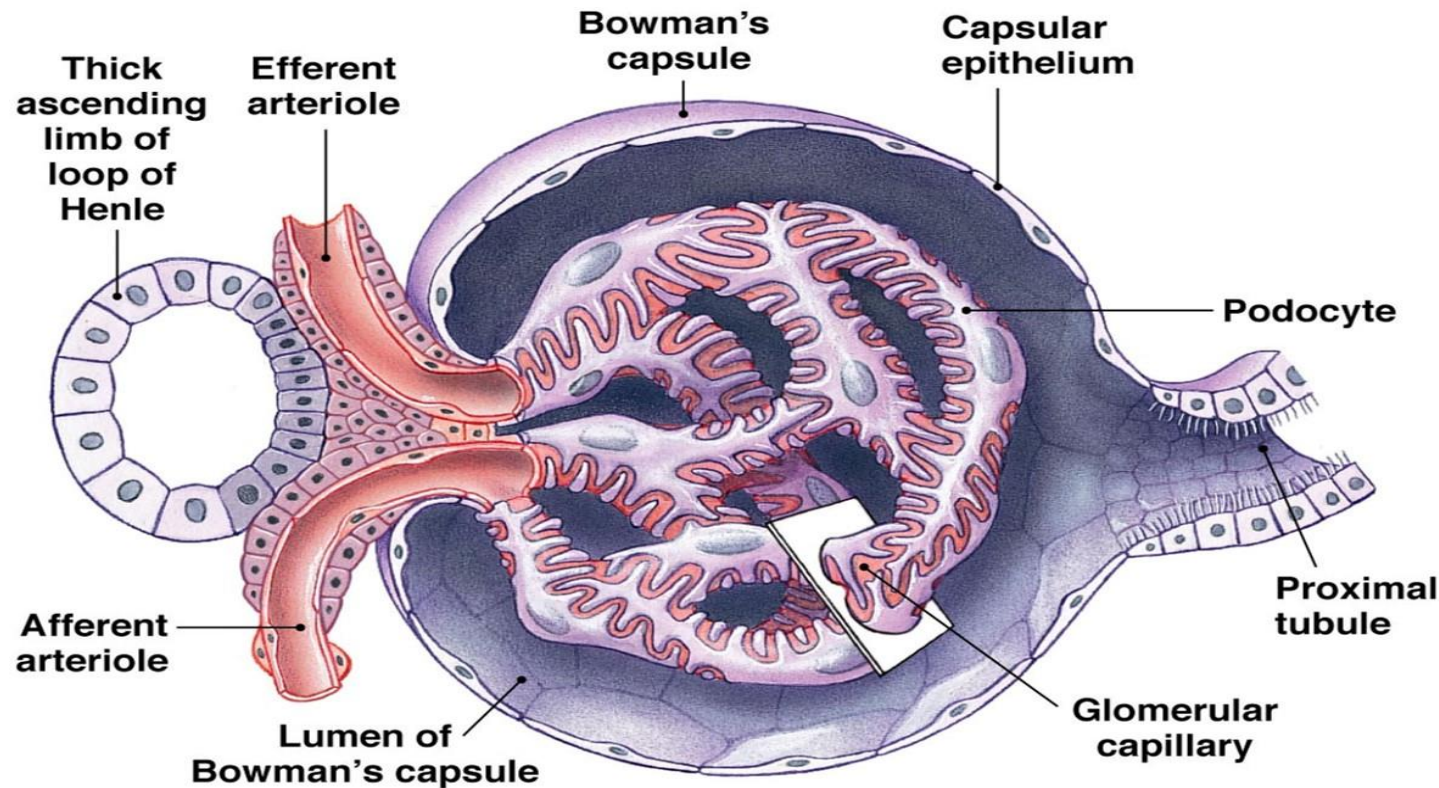
- Renal corpuscle or malpighian corpuscle is a **spheroidal** and slightly flattened structure with a diameter of about **200 $\mu$**
- Renal corpuscle is formed by two portions:
  - **Glomerulus** (cluster of microscopic blood vessels)
  - **Bowman capsule** (cuplike structure)



# GLOMERULUS

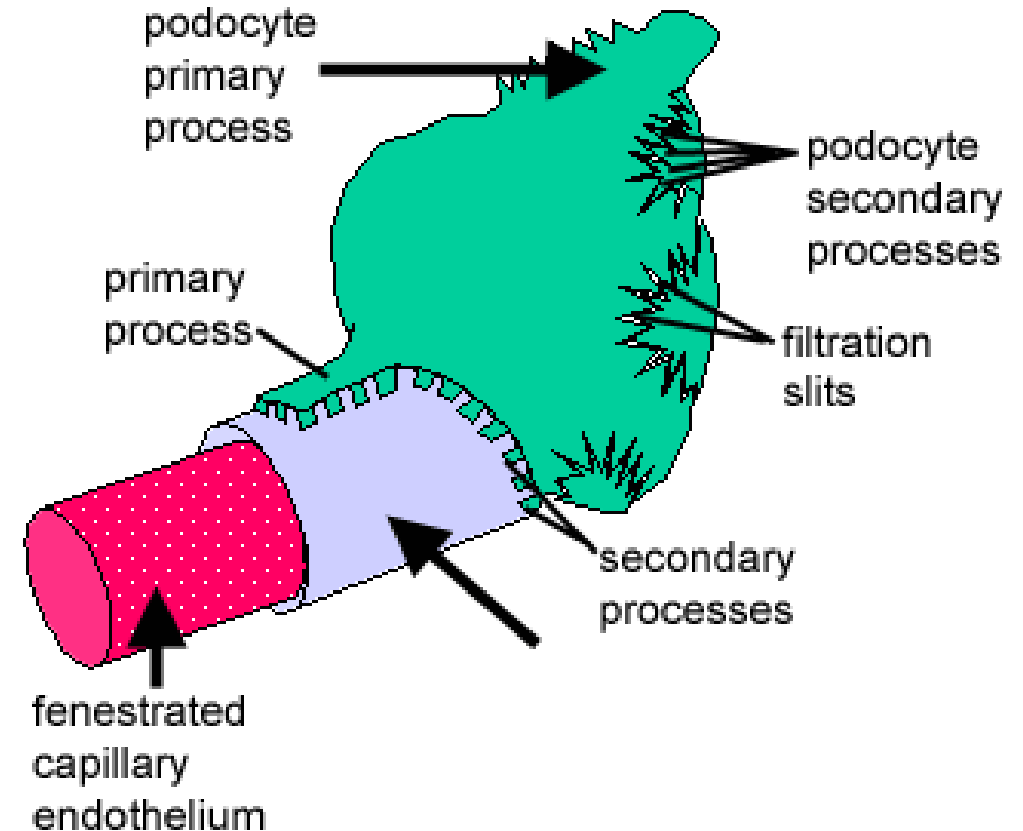
- Glomerulus is a **tuft of capillaries** enclosed by bowman capsule.
- It consists of glomerular capillaries interposed between **afferent arteriole** on one end and **efferent arteriole** on the other end.
- Diameter of the efferent arteriole is less than that of afferent arteriole.
- Substance which are  $< 8 \text{ nm}$  are freely filtered and those  $> 8 \text{ nm}$  are not filtered at all.

(a) The epithelium around glomerular capillaries is modified into podocytes.



# HISTOLOGY OF GLOMERULUS

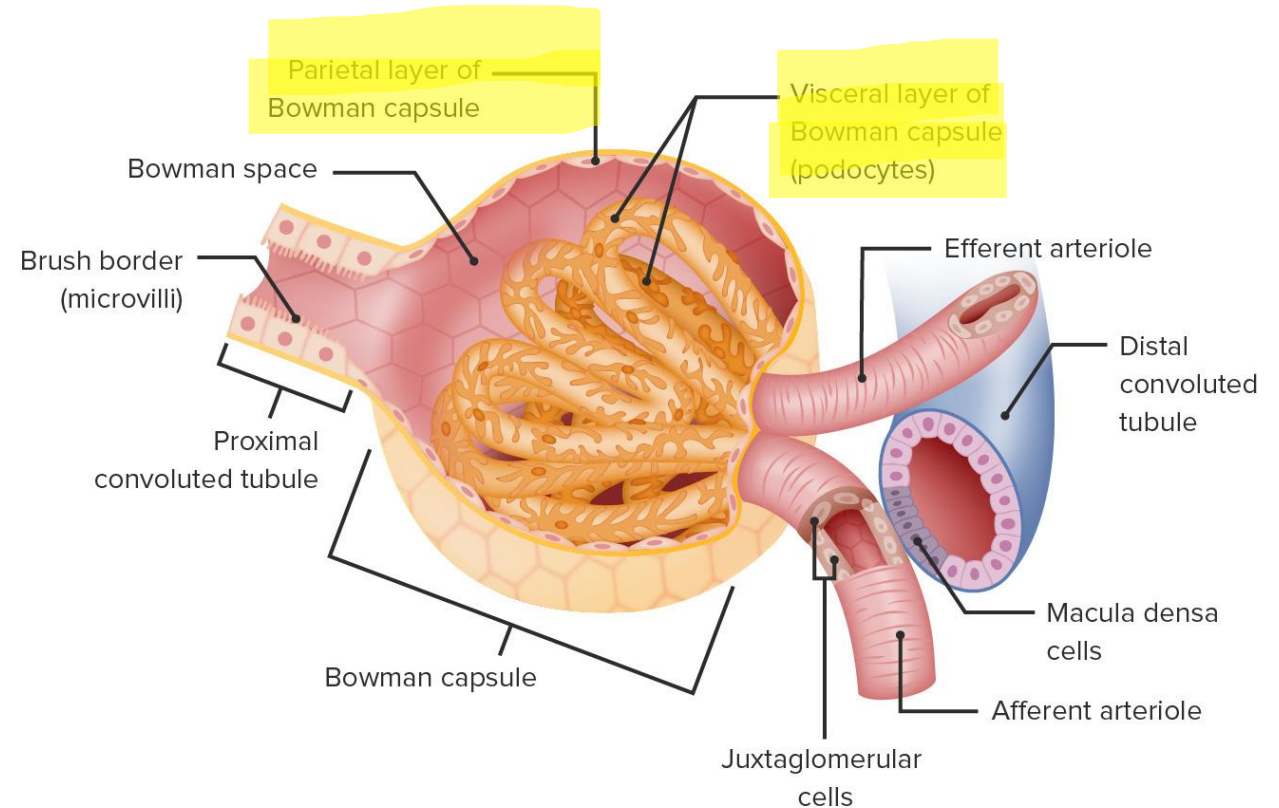
- Glomerular capillaries are made up of ***single layer of endothelial cells***, which are attached to the basement membrane.
- Endothelium has many pores called fenestrae or ***filtration pores***.
- Diameter of each pore is ***0.1 $\mu$***





# BOWMAN'S CAPSULE

- Bowman capsule is a capsular structure, which encloses the glomerulus.
- Bowman's Capsule is made up of ***simple squamous epithelium cells***.
- It divides into three layers: Outer (Parietal Layer), Middle (Basement Layer), Inner (Visceral Layer).

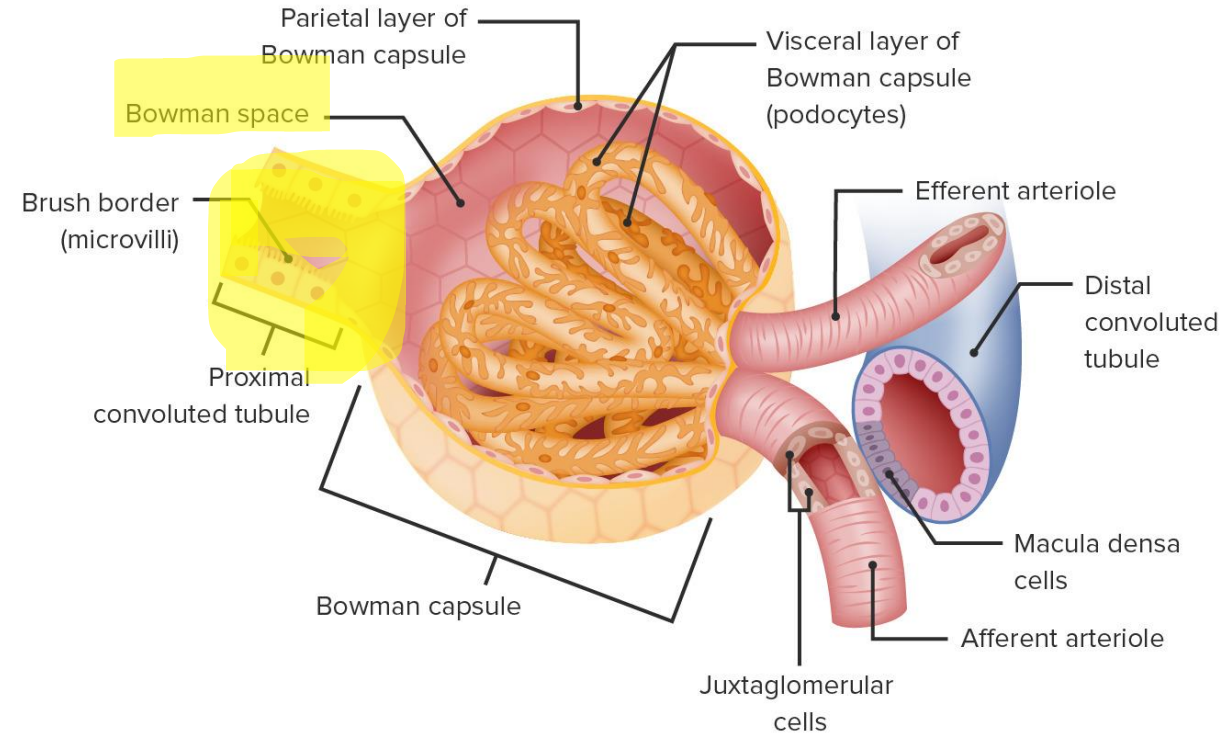


# BOWMAN'S CAPSULE

Parietal layer is continued with the wall of the **tubular portion** of nephron.

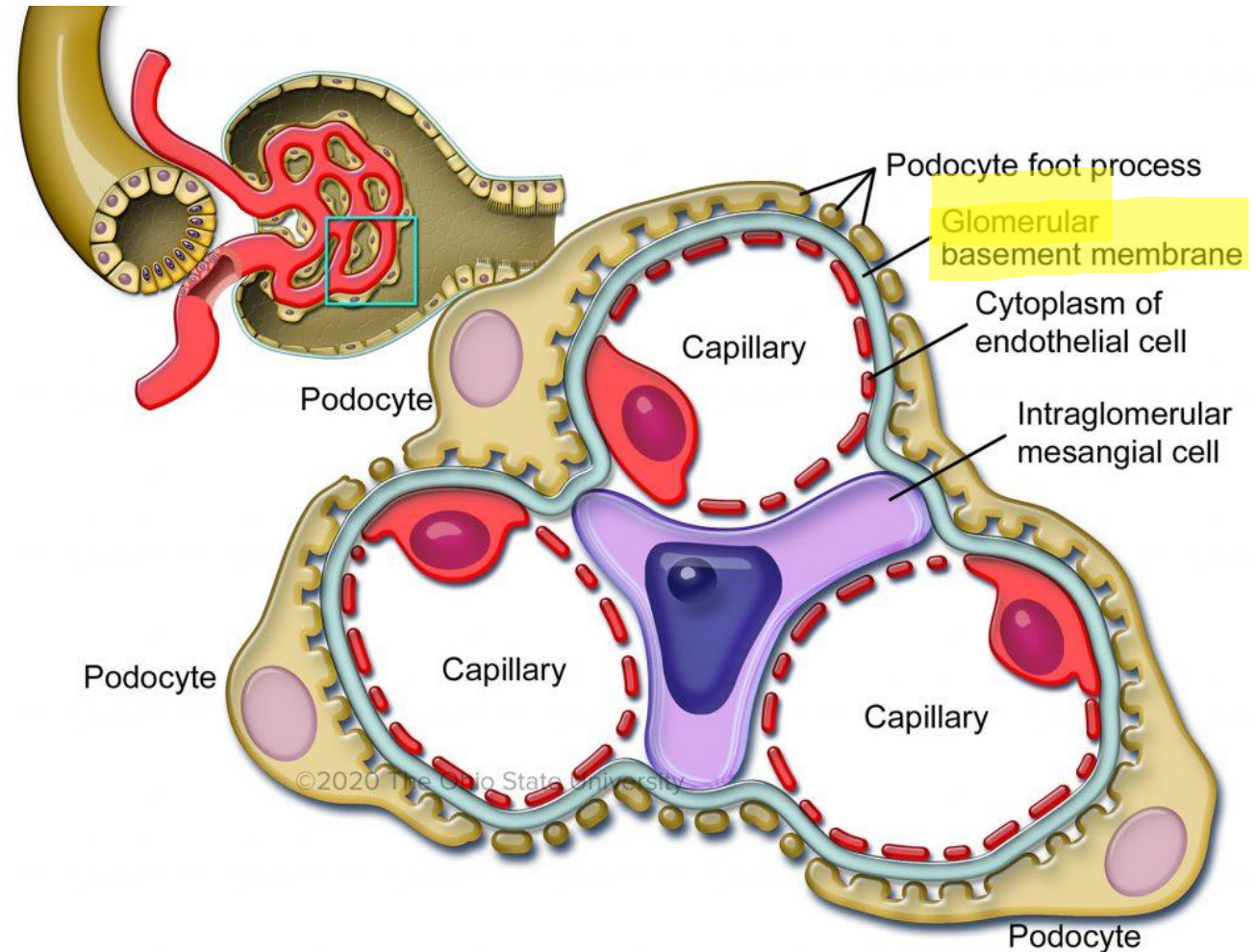
The cleft-like space (**bowman's space**) between the visceral and parietal layers is continued as the lumen of the tubular portion.

Diameter of bowman capsule is **200 $\mu$** .



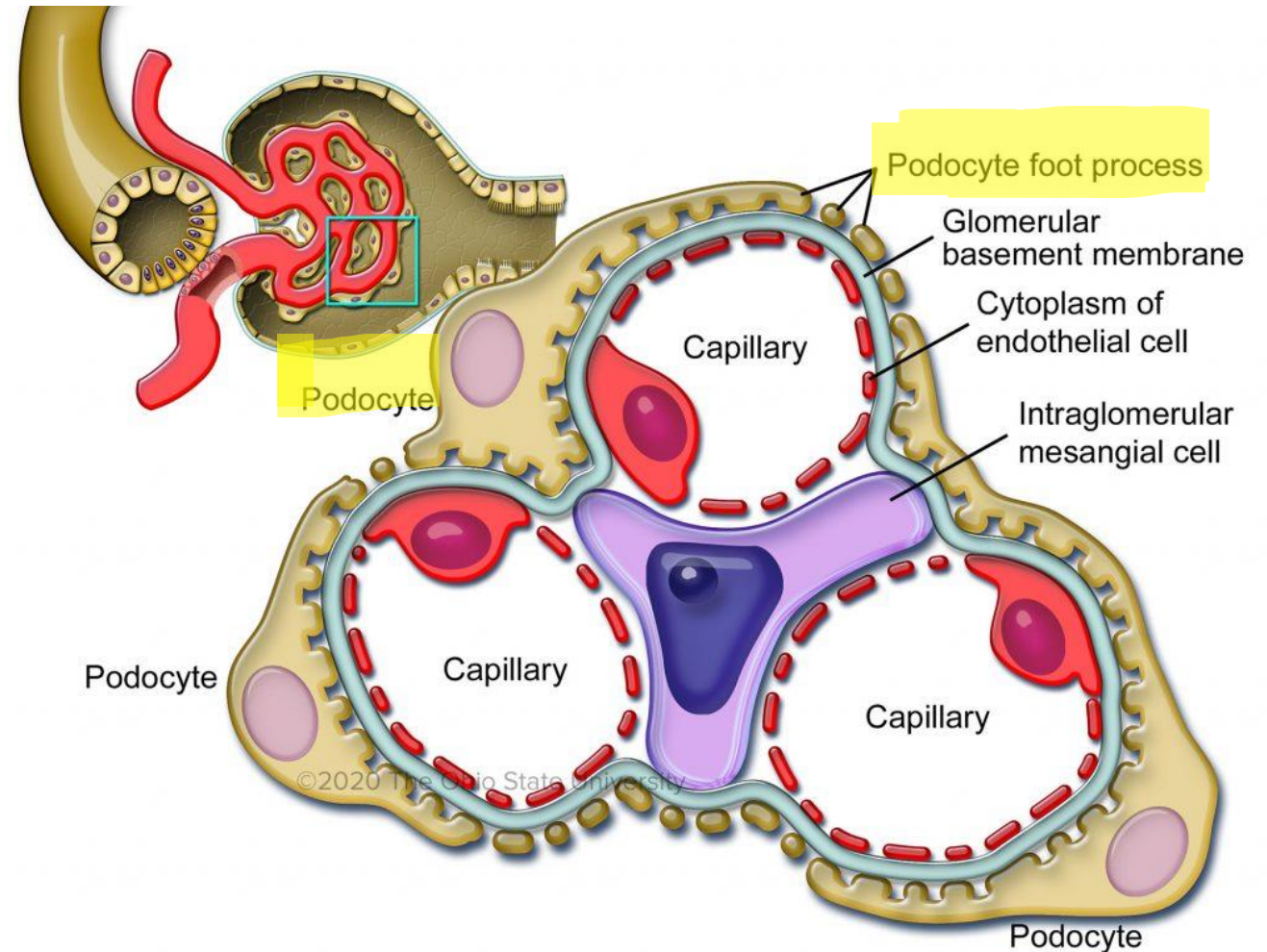
# HISTOLOGY OF BOWMAN'S CAPSULE

- Basement membrane of the visceral layer fuses with the basement membrane of glomerular capillaries
- On the basement membrane of glomerular capillaries, the *capillary endothelial cells* are arranged



# HISTOLOGY OF BOWMAN'S CAPSULE

- cytoplasmic extensions of epithelial cells called ***pedicles*** or feet.
- The cleft-like space between pedicles is called ***slit pore***.
- Epithelial cells with pedicles are called ***podocytes***.





## ASSESSMENT - IV



- Functional unit of kidney is called as -----
- How many nephrons are there in each kidney?
- Other name for Renal Corpuscle -----
- Parts of renal tubule -----
- Classification of Nephron -----
- Parts of renal corpuscle -----
- -----is a tuft of capillaries enclosed by bowman capsule.
- What is podocytes ?



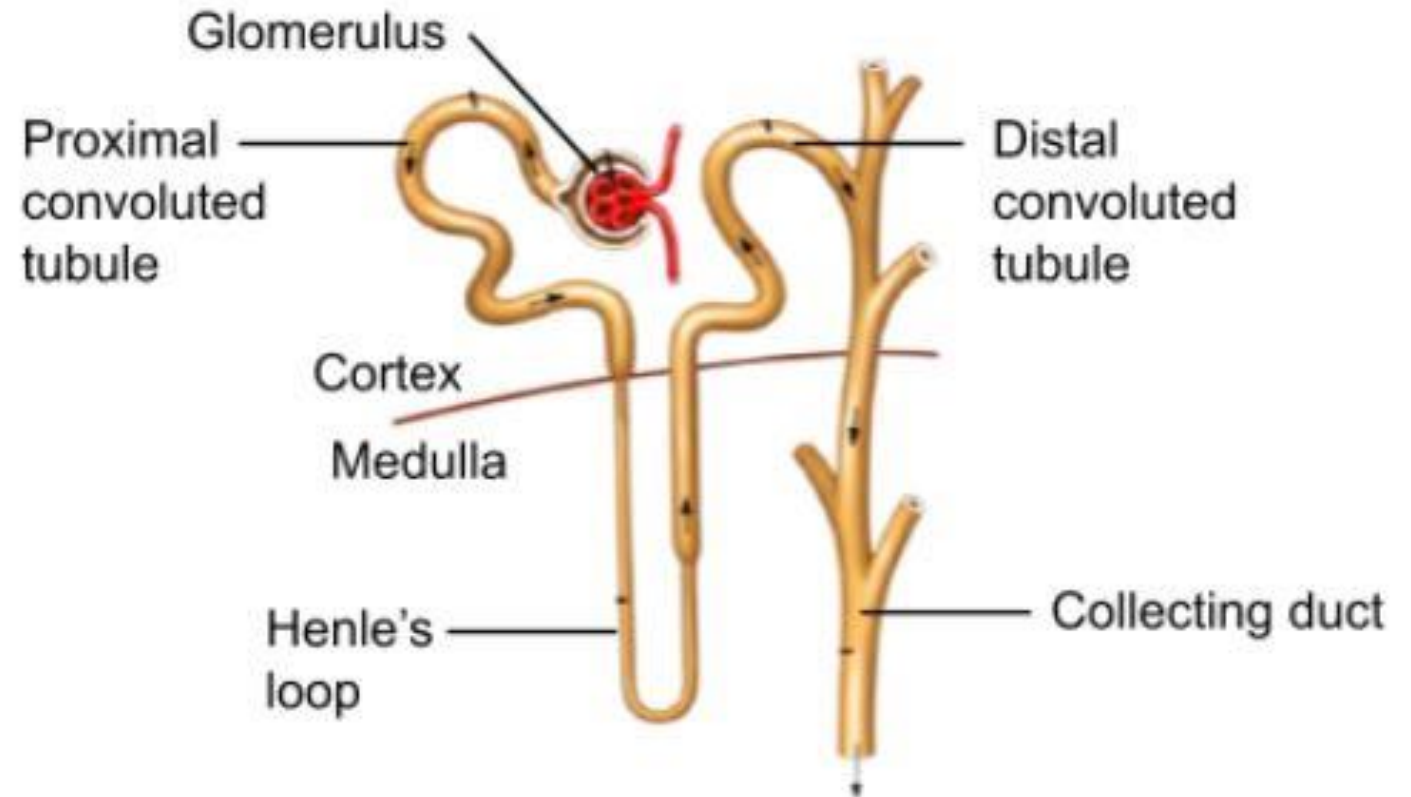
# TUBULAR PORTION OF NEPHRON



Tubular portion of nephron is the continuation of Bowman capsule.

It is made up of three parts:

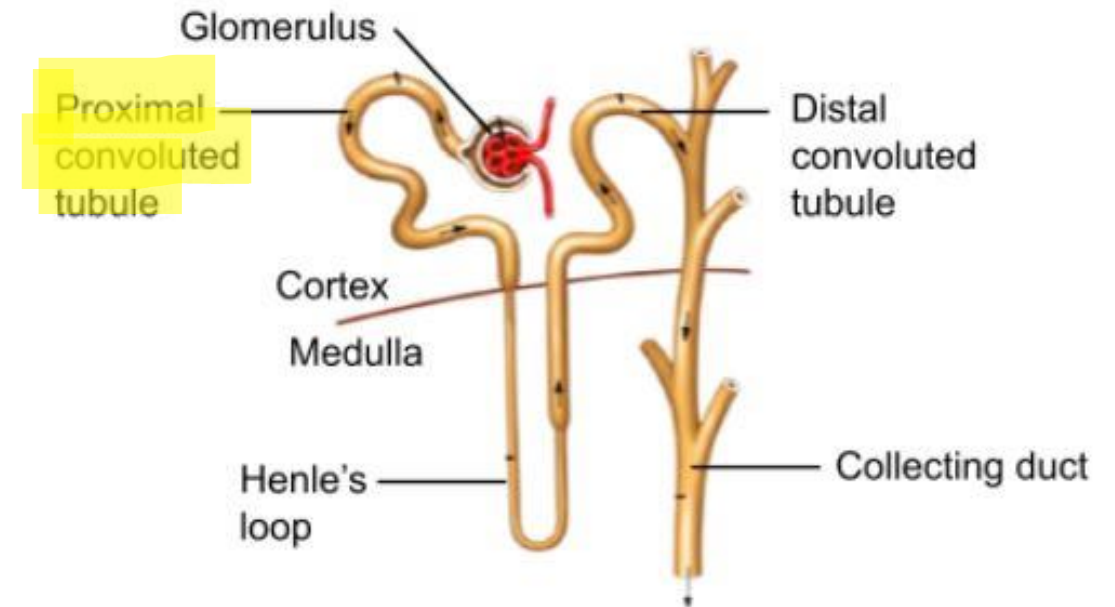
- ***Proximal convoluted tubule***
- ***Loop of Henle***
- ***Distal convoluted tubule.***



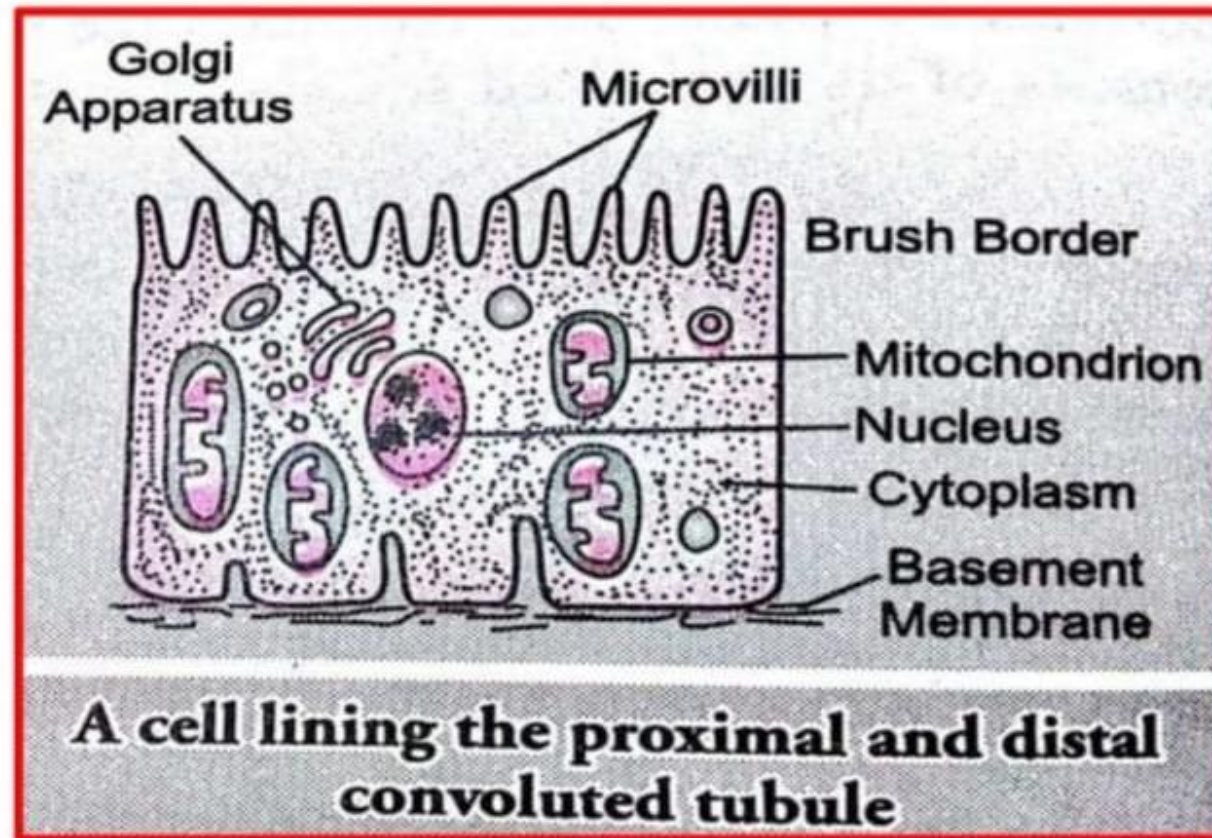
## PROXIMAL CONVOLUTED TUBULE

- Proximal convoluted tubule is the ***coiled portion*** arising from Bowman capsule.
- It is situated in the ***cortex***.
- Length of proximal convoluted tubule is ***14mm*** and the diameter is ***55 μ***.
- Proximal convoluted tubule is continued as loop of Henle.
- It has ***single layer of cuboidal epithelial cells***.

- Hair like projections are present so, it is called as ***brush-bordered cells***.



# PROXIMAL CONVOLUTED TUBULE

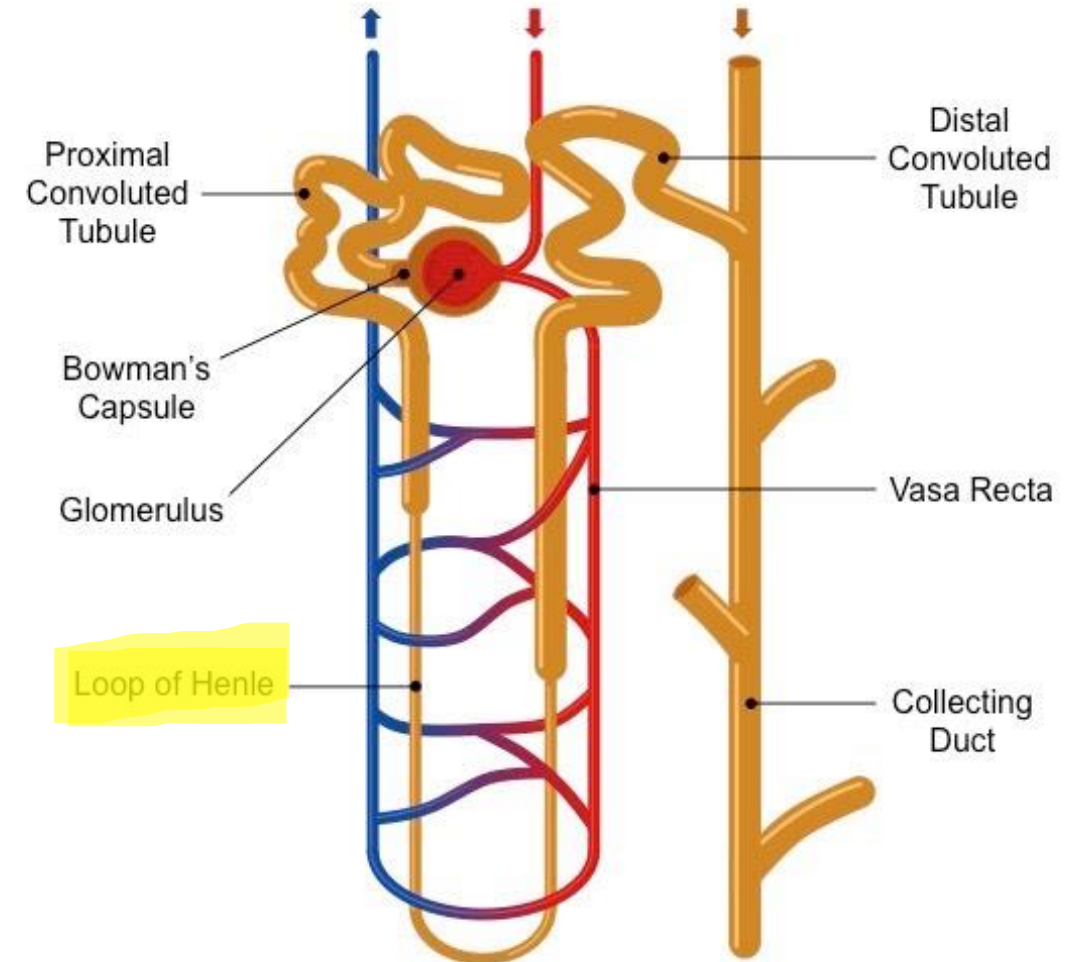




## LOOP OF HENLE

Loop of Henle consists of:

- ***Descending limb*** - ***Thick and thin segment***
- It has a ***length of 6 mm*** and a ***diameter of 55  $\mu$*** .
- ***Hairpin bend*** - ***Flattened Epithelial cells without brush border***
- ***Ascending limb*** - ***Thick and thin segment***
- It has a ***length of 9 mm*** long with a diameter of ***30  $\mu$*** .

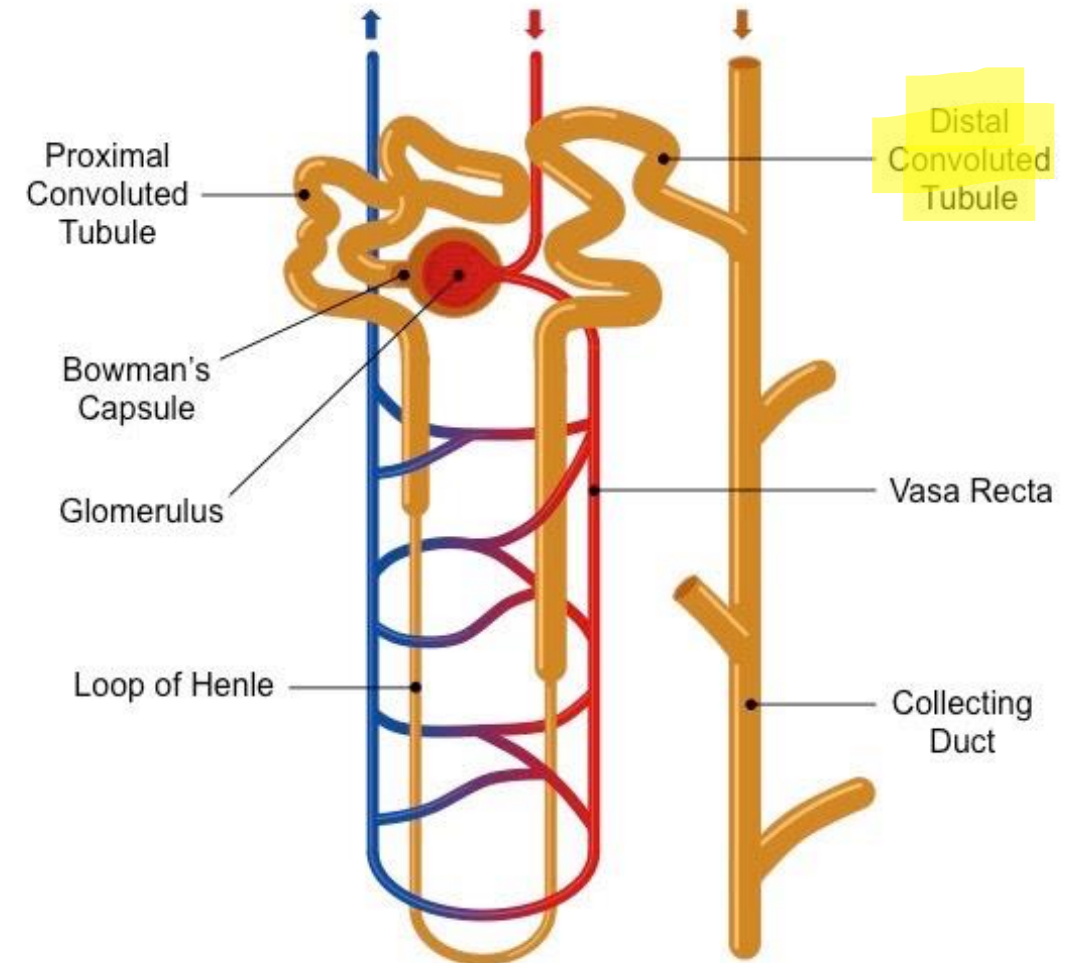




## DISTAL CONVOLUTED TUBULE



- Distal convoluted tubule is the continuation of thick ascending segment and occupies the cortex of kidney.
- It is continued as collecting duct.
- The length of the distal convoluted tubule is **14.5 to 15 mm**.
- It has a diameter of **22 to 50  $\mu$**

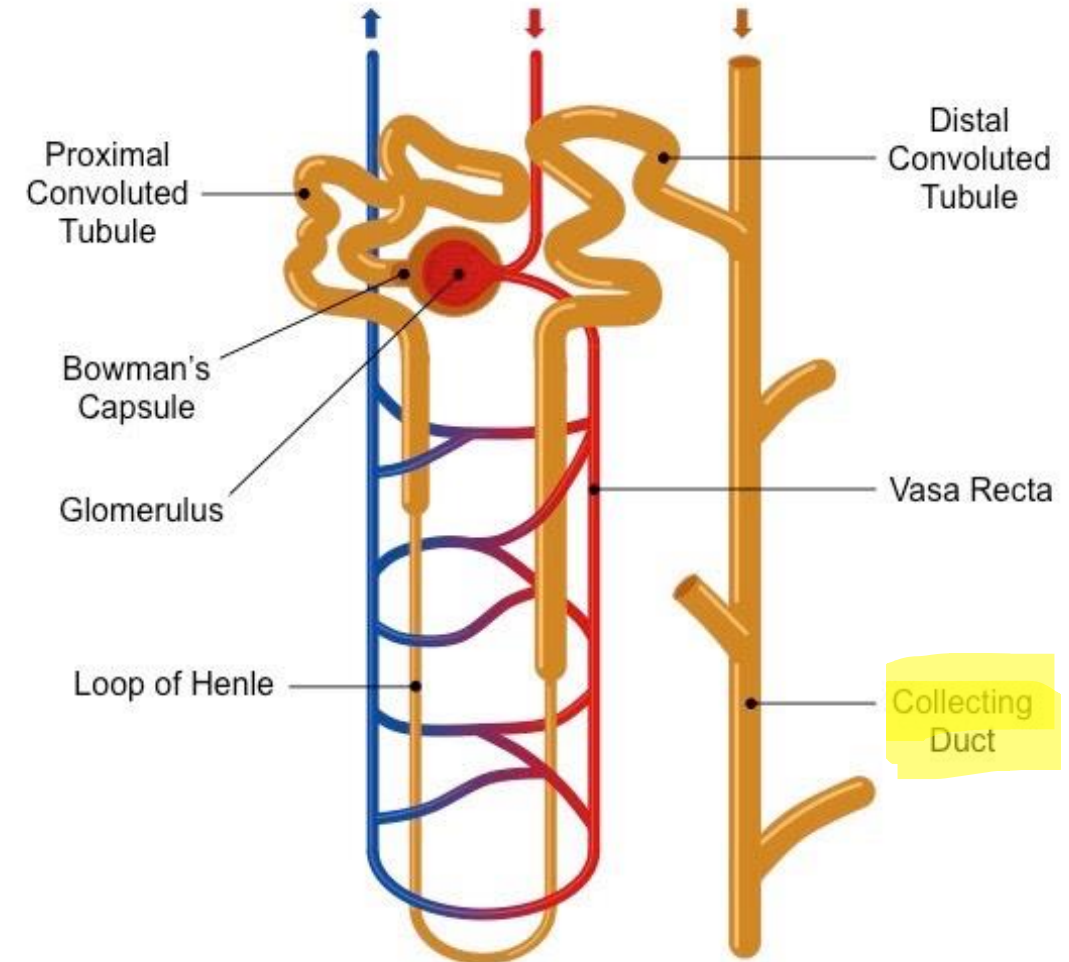




## COLLECTING DUCT



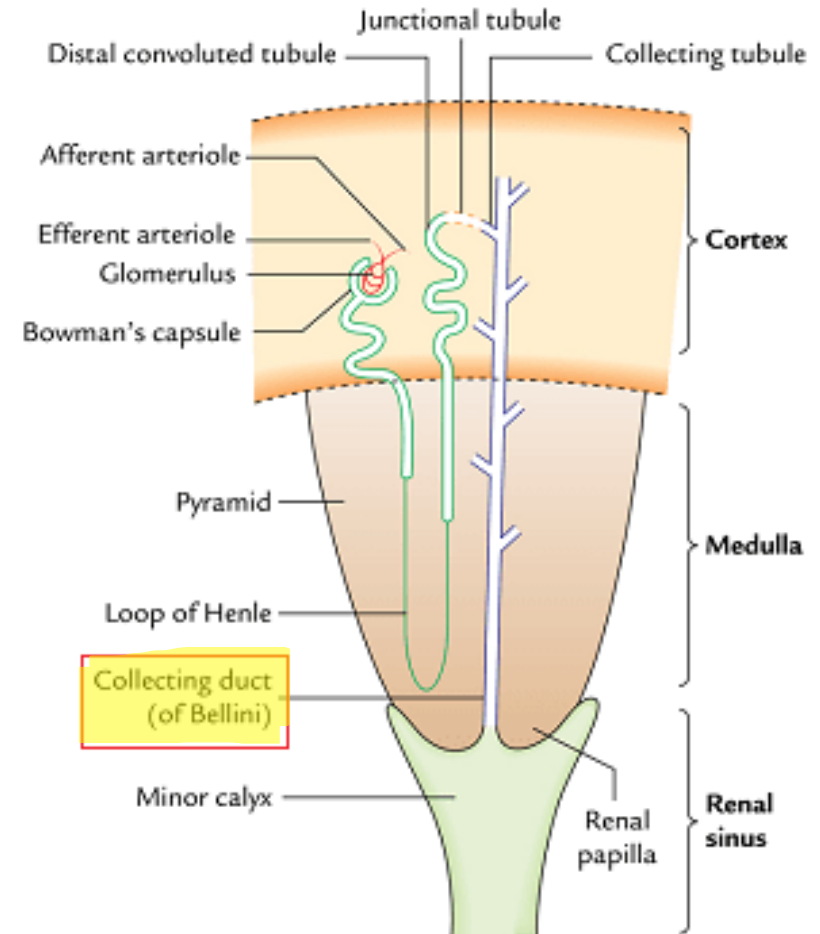
- Distal convoluted tubule continues as the initial or arched **collecting duct**, which is in cortex.
- The lower part of the collecting duct lies in medulla.
- Length of the collecting duct is **20 to 22 mm** and its diameter varies between **40 and 200  $\mu$**
- Collecting duct is formed by **cuboidal or columnar epithelial cells**.



# COLLECTING DUCT

Collecting duct is formed by two types of epithelial cells:

- Principal or **P cells**
- Intercalated or **I cells.**
- The urine collected from the pyramid unite to form ***papillary ducts*** or ***ducts of Bellini***
- ***The urine then flows to minor calyx and then enter to major calyx***
- Each kidney has got about ***8 minor calyces*** and ***2 to 3 major calyces.***
- Then urine flows to **pelvis** of the **ureter**





## ASSESSMENT – V



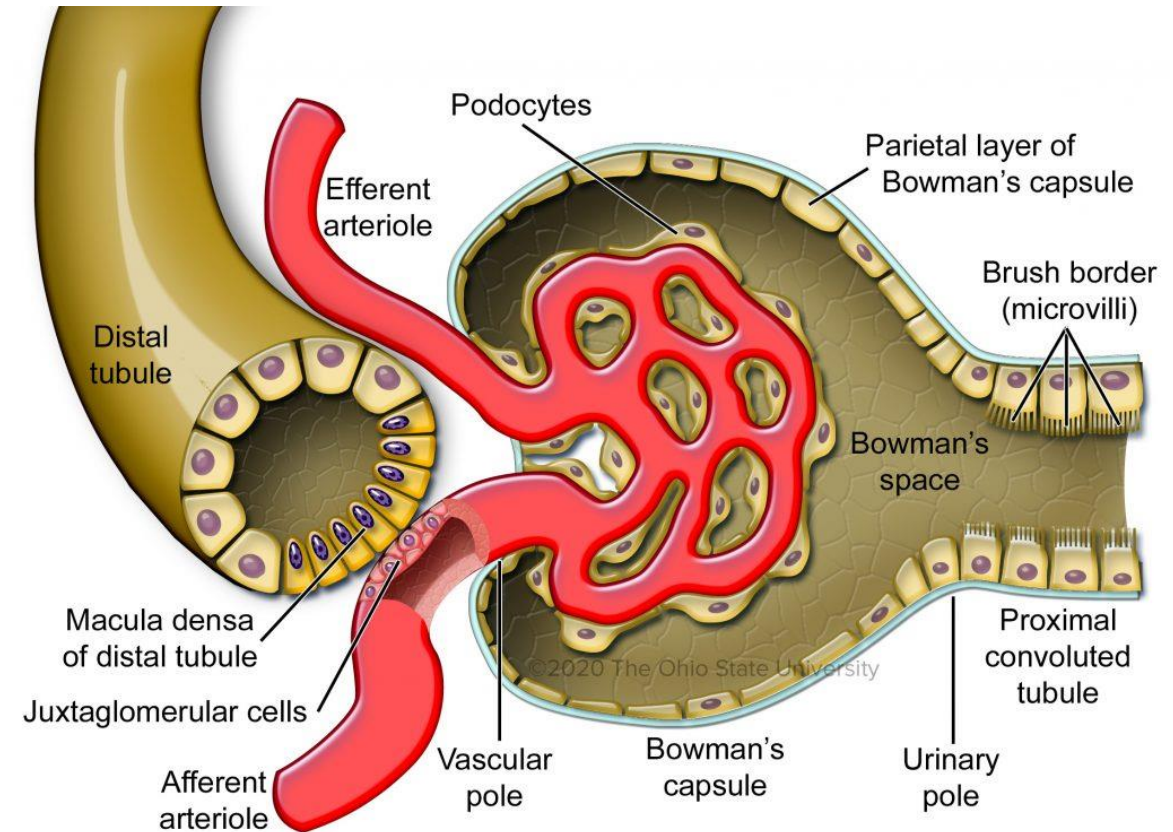
- What are the tubular parts of nephron?
- Parts of Henle Loop
- Distal convoluted tubule drains into -----
- What is ducts of Bellini?

# JUXTAGLOMERULAR APPARATUS

- The thick ascending loop of henle when comes in contact with the glomerulus, structural modification occurs in the tubule and afferent and efferent arterioles.
- The entire modified structure is called as Juxtaglomerular apparatus

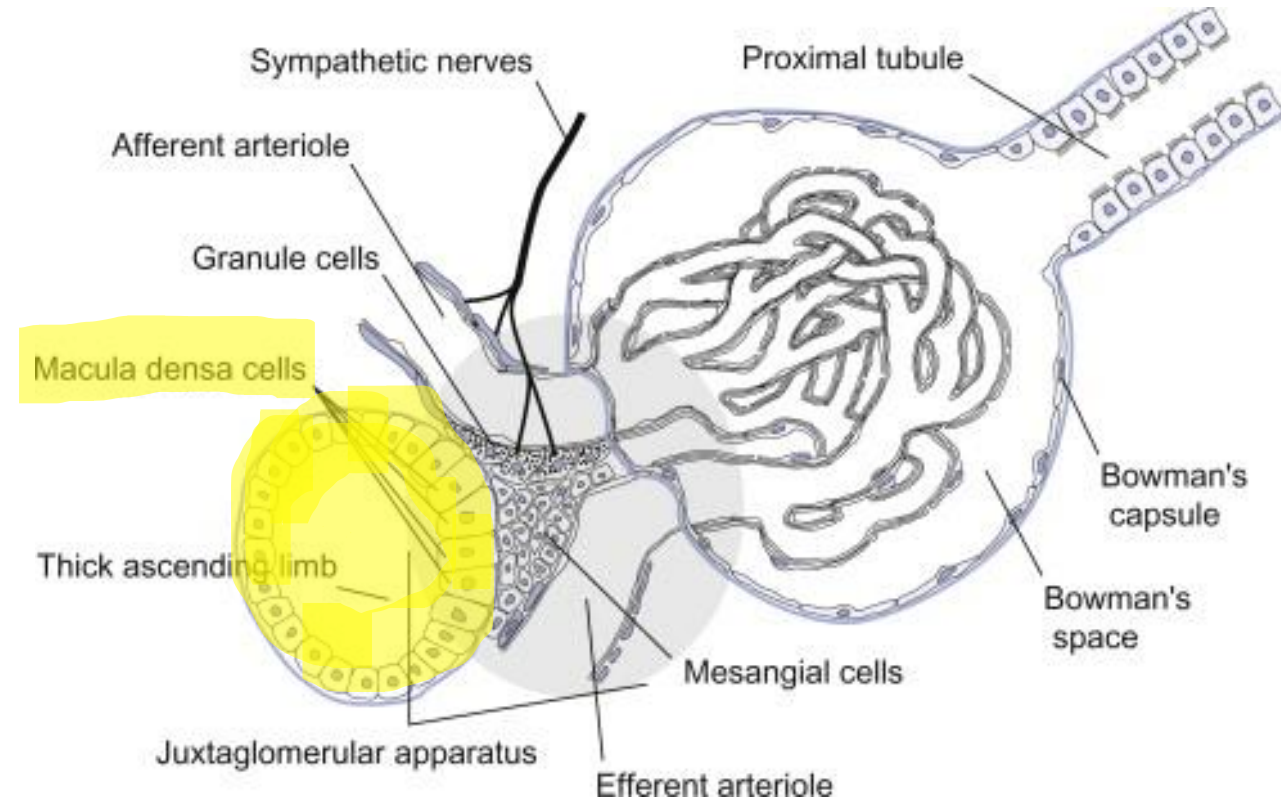
It includes,

- **Macula Densa**
- **Juxtaglomerular cells**
- **Lacis Cells (Extraglomerular mesangial cells)**



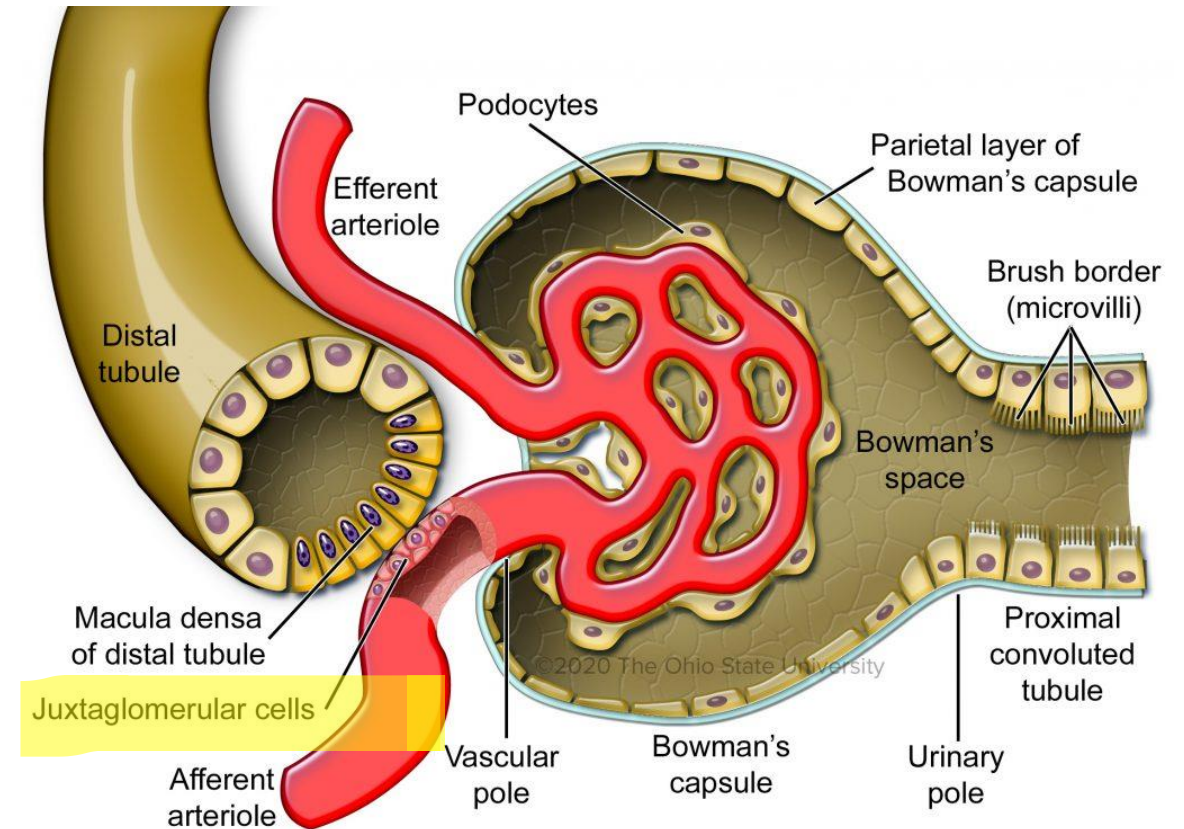
# MACULA DENSA

- It is a **modified epithelial cells** of thick ascending loop of Henle.
- This appears as **dense area**
- Macula densa acts as a sensor that monitors the change in ionic composition and rate of blood flow of the tubular fluid.



# JUXTAGLOMERULAR APPARATUS

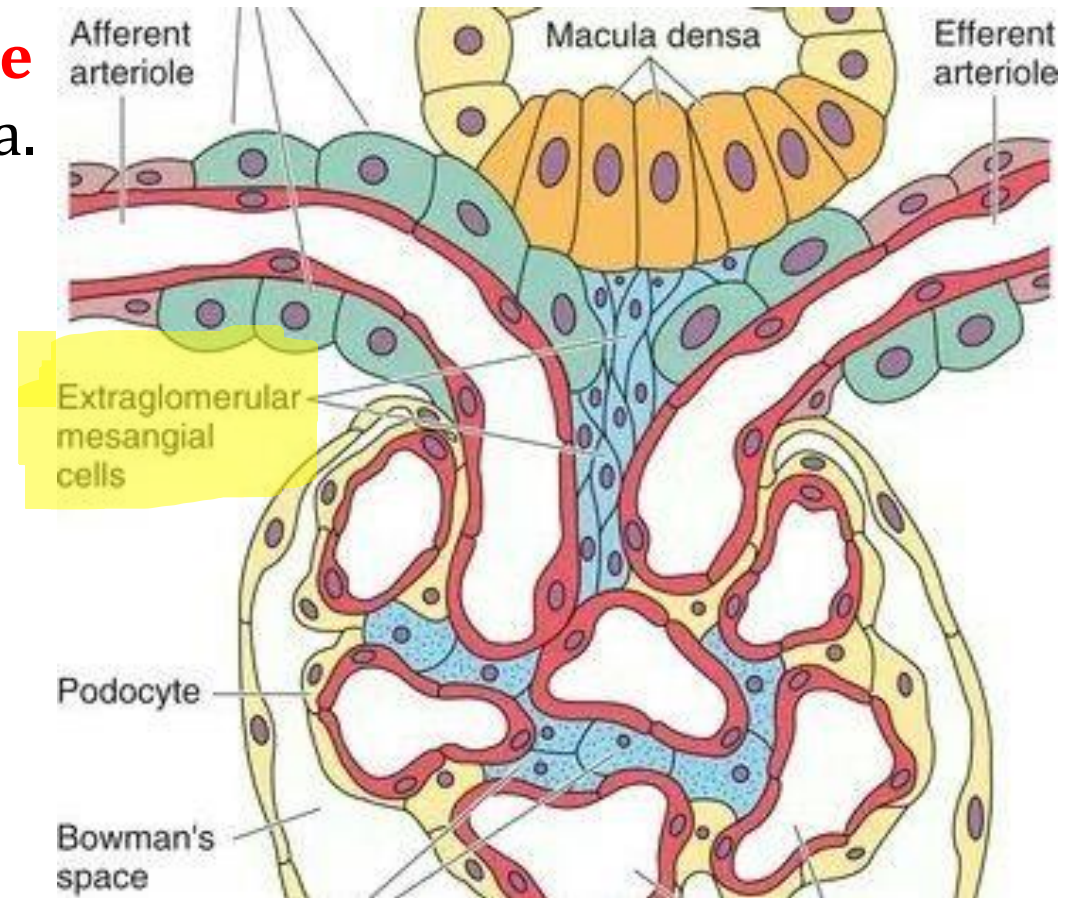
- JG Cells are the **granular epitheloid cells**.
- Present in the tunica media of the afferent arteriole
- The granular cells are vascular smooth muscle cells
- It contain secretory **granule**
- They are also called as **Polkissen cells**
- It secrete **renin**.





## LACIS CELLS

- Lacis cells are present in the **triangular space** formed by efferent, afferent and macula densa.
- It is present outside the glomerulus so, it is called as **extraglomerular cells**.
- They are agranular cells.
- They secrete some amount of renin and erythropoietin



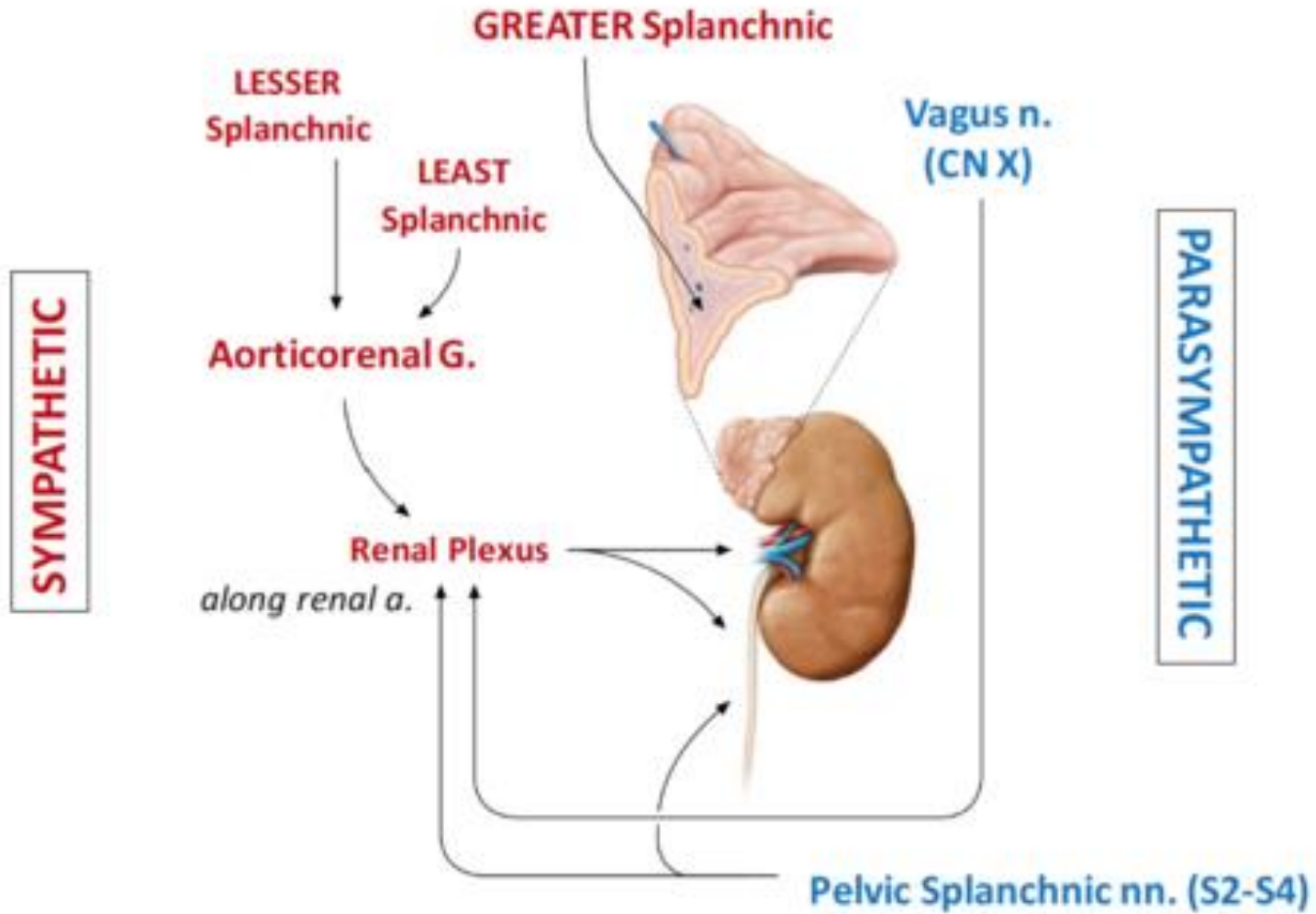


## ASSESSMENT VI



- What are the cells present in Juxtaglomerular Apparatus ?
- Which cells are granular epithelial cells?
- Granular cells secrete which hormone?
- What is the other name for Lacis cells?

# Innervation of the Kidney & Adrenal Gland





**THANK YOU**



References:

<https://anatomyqa.com/kidney-anatomy/>

<https://teachmeanatomy.info/abdomen/viscera/kidney/>

Text book of medical physiology, professor G.K Pal