The urinary system I

HISTOLOGY

Semester 2, Year 3

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The urinary system consists of ·

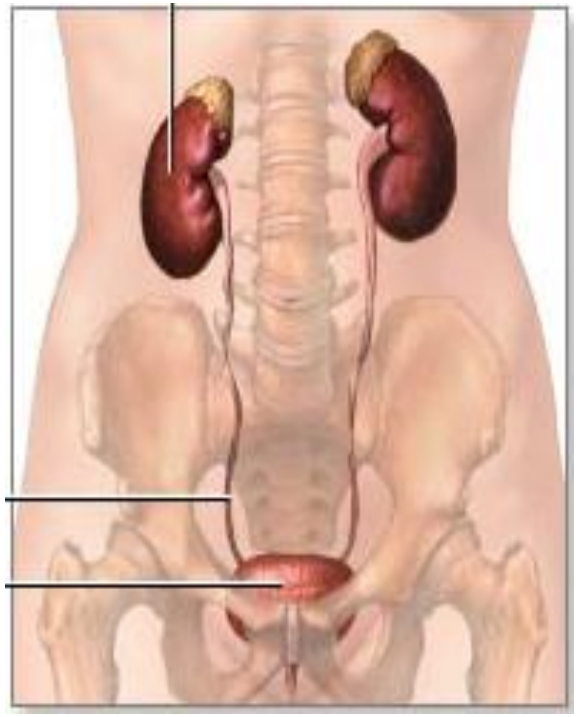
2 kidneys (Filtrate blood)

2 ureters

Urinary bladder

Urethra

:Function ·



Removing waste & water from body ·

Reabsorption of vital nutrients ·

Maintain acid /base balance ·

Help in control blood pressure ·

Help in produce red blood cells (EPO Hormone) ·

Produce Calcitriol (Vit. D) regulate Ca^{+} → healthy bones

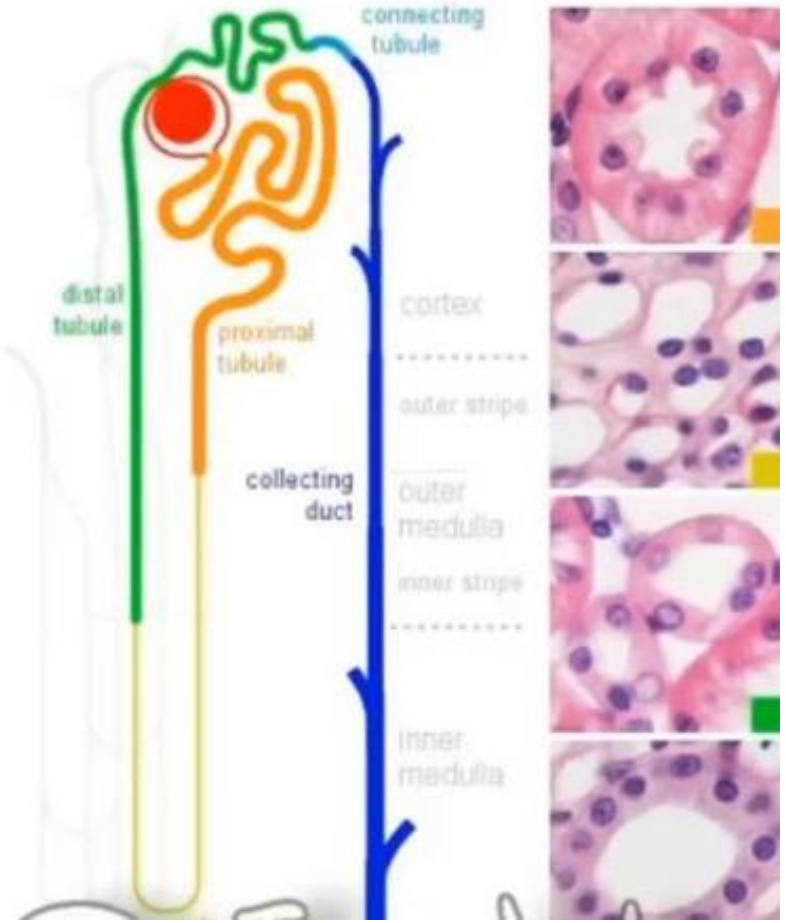
The uriniferous tubule

- It is formed :

A. The nephron: consists of:

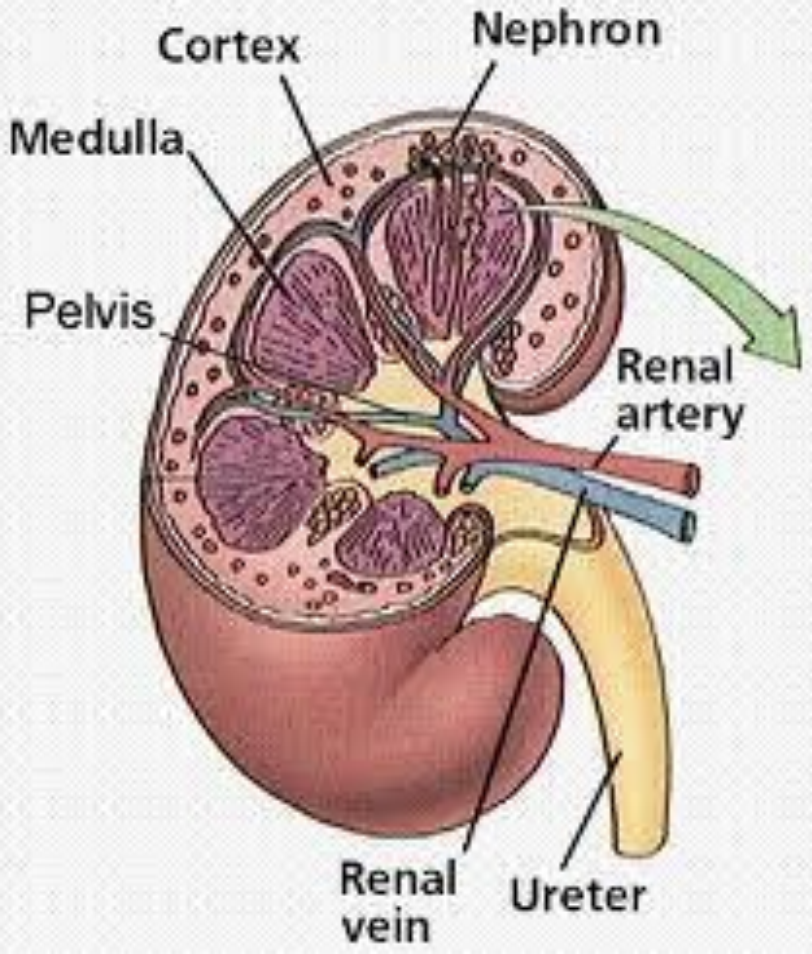
- Renal corpuscle.
- Proximal convoluted tubule (PCT).
- Loop of Henle.
- Distal convoluted tubule (DCT).
- A connecting tubule.

B. The collecting duct.



Structure of the kidney:

1. Cortex (outer part).
2. Medulla (inner part).



Histological section of the kidney

A-Cortex:

- It is the dark outer layer.
- It has a granular appearance due to presence of the renal corpuscles and the convoluted renal tubules.

B-Medulla:

- It is the pale inner layer.
- It has a striated appearance due to the longitudinally arranged straight renal tubules, collecting ducts& the surrounding vessels.

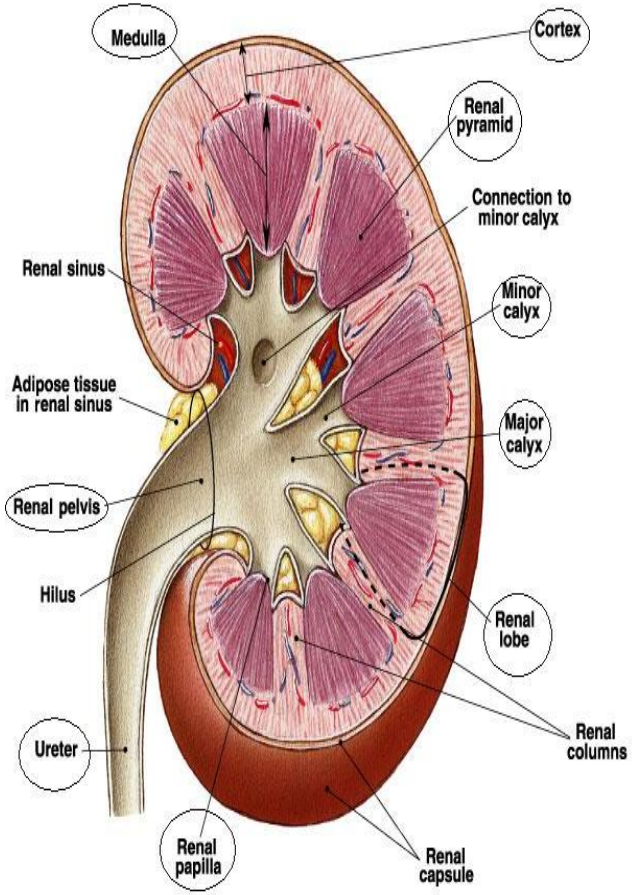
90-95% of blood passes through the cortex and only 5-10% pass through the medulla).

Cortex: contains

Cortical labyrinth + medullary rays

+ renal columns

Cortical labyrinth: contains renal corpuscles and **convoluted tubules**



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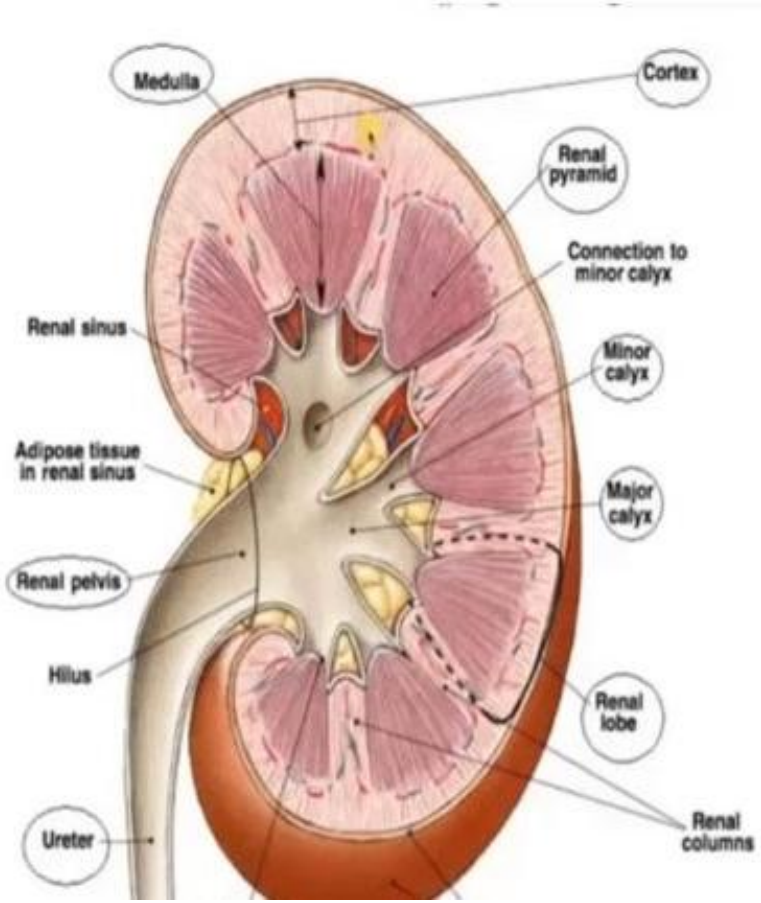
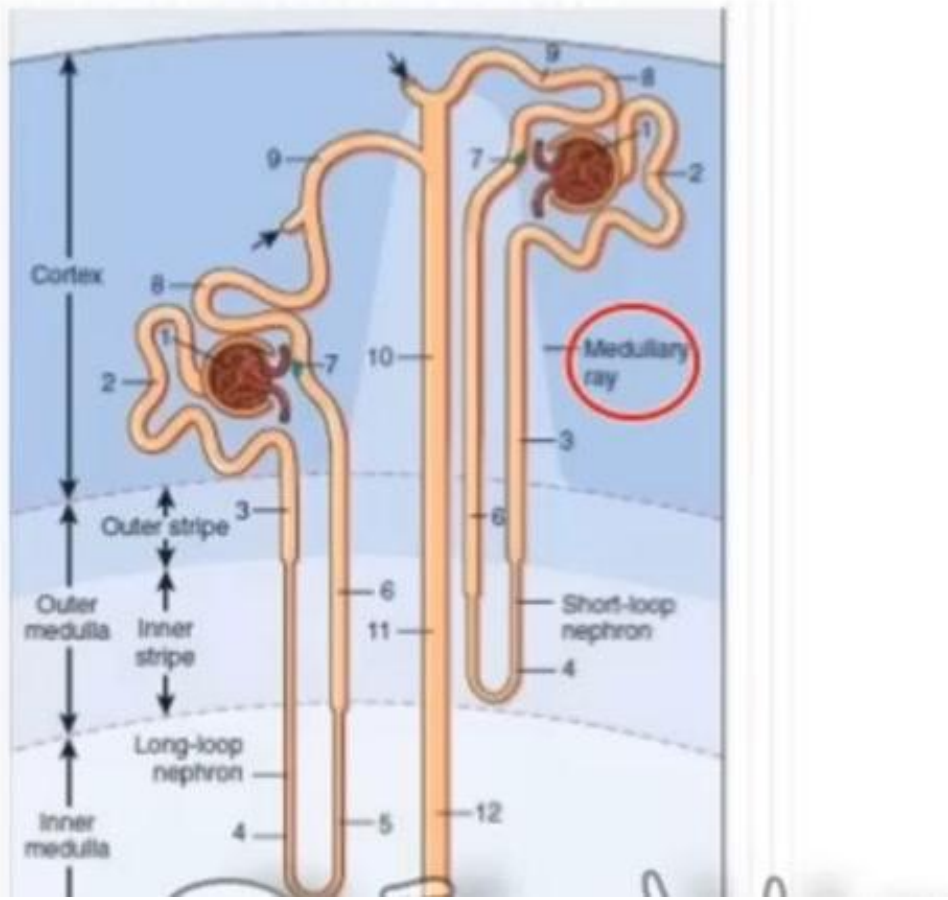
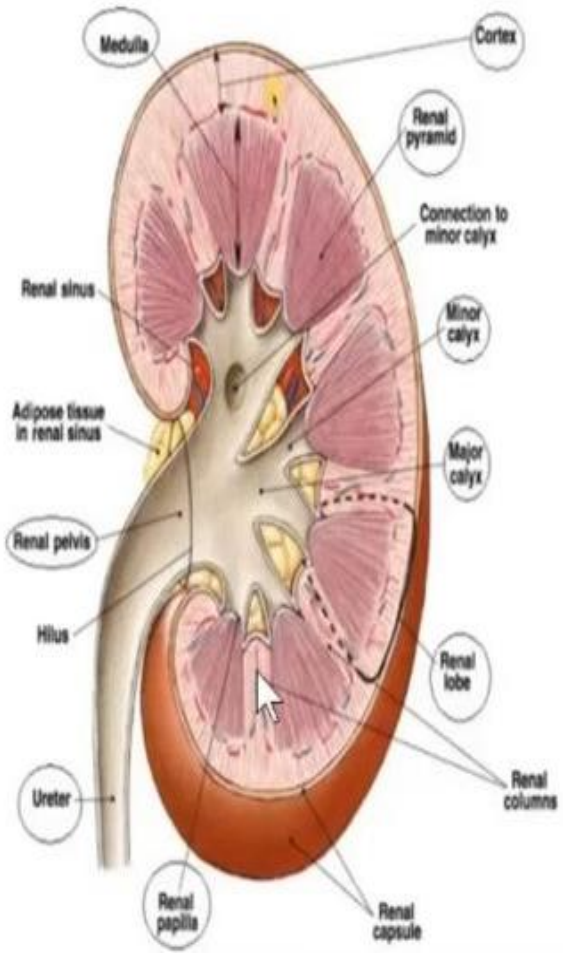
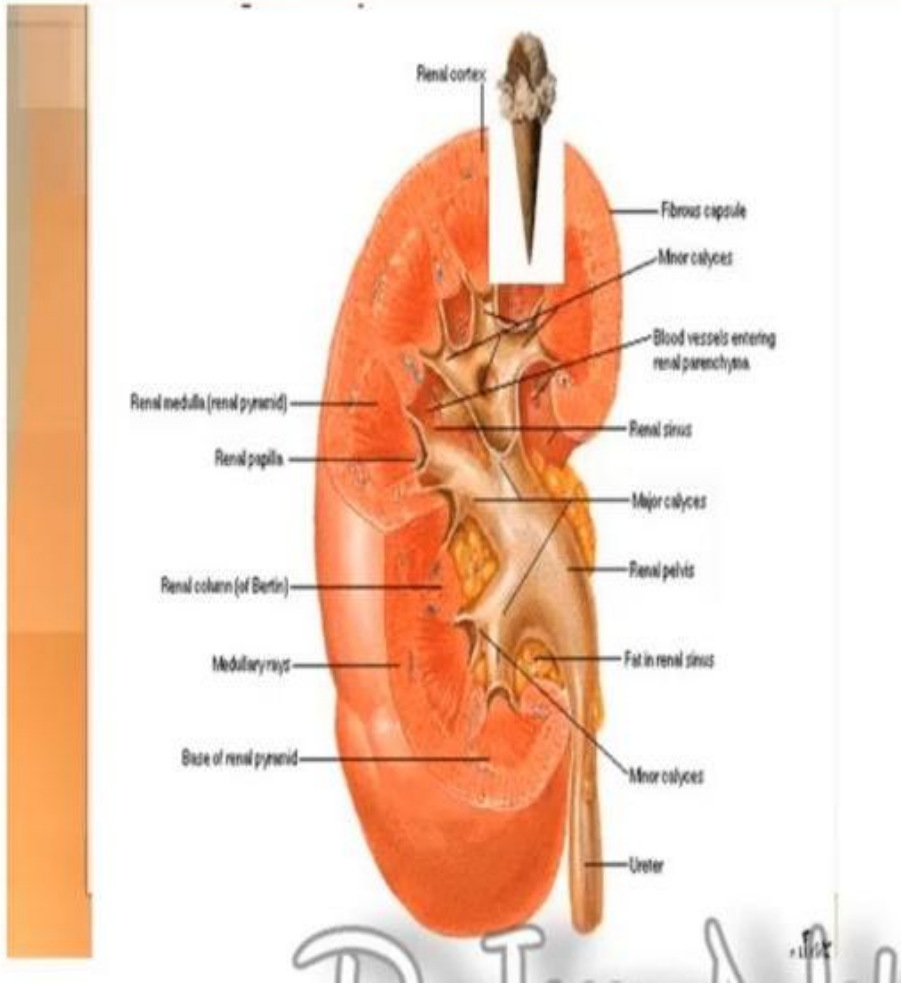
Medullary ray: striations extend from the medulla into the cortex, represent straight segments of the renal tubules+ cortical collecting ducts.





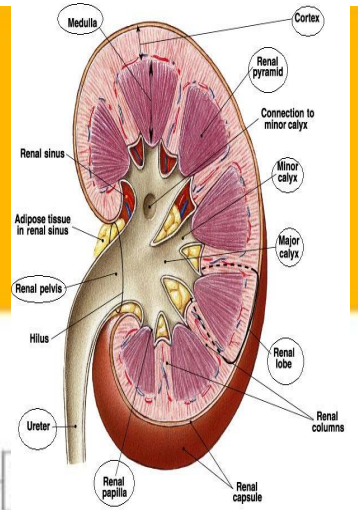
Renal columns: extension from cortex into the medulla between the medullary pyramids.

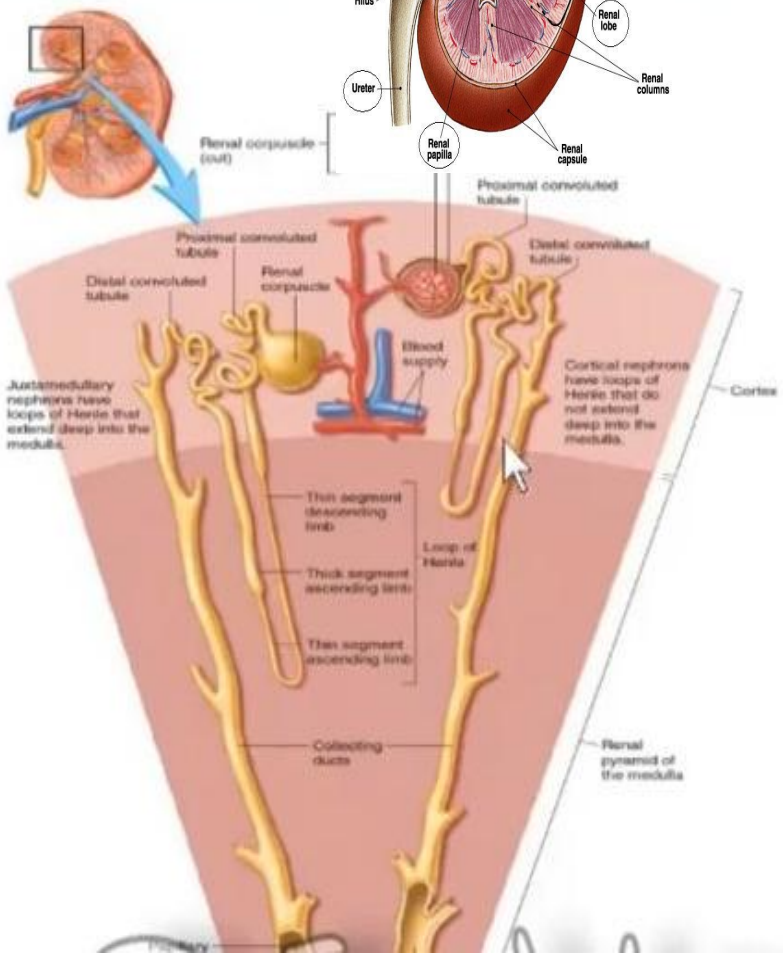


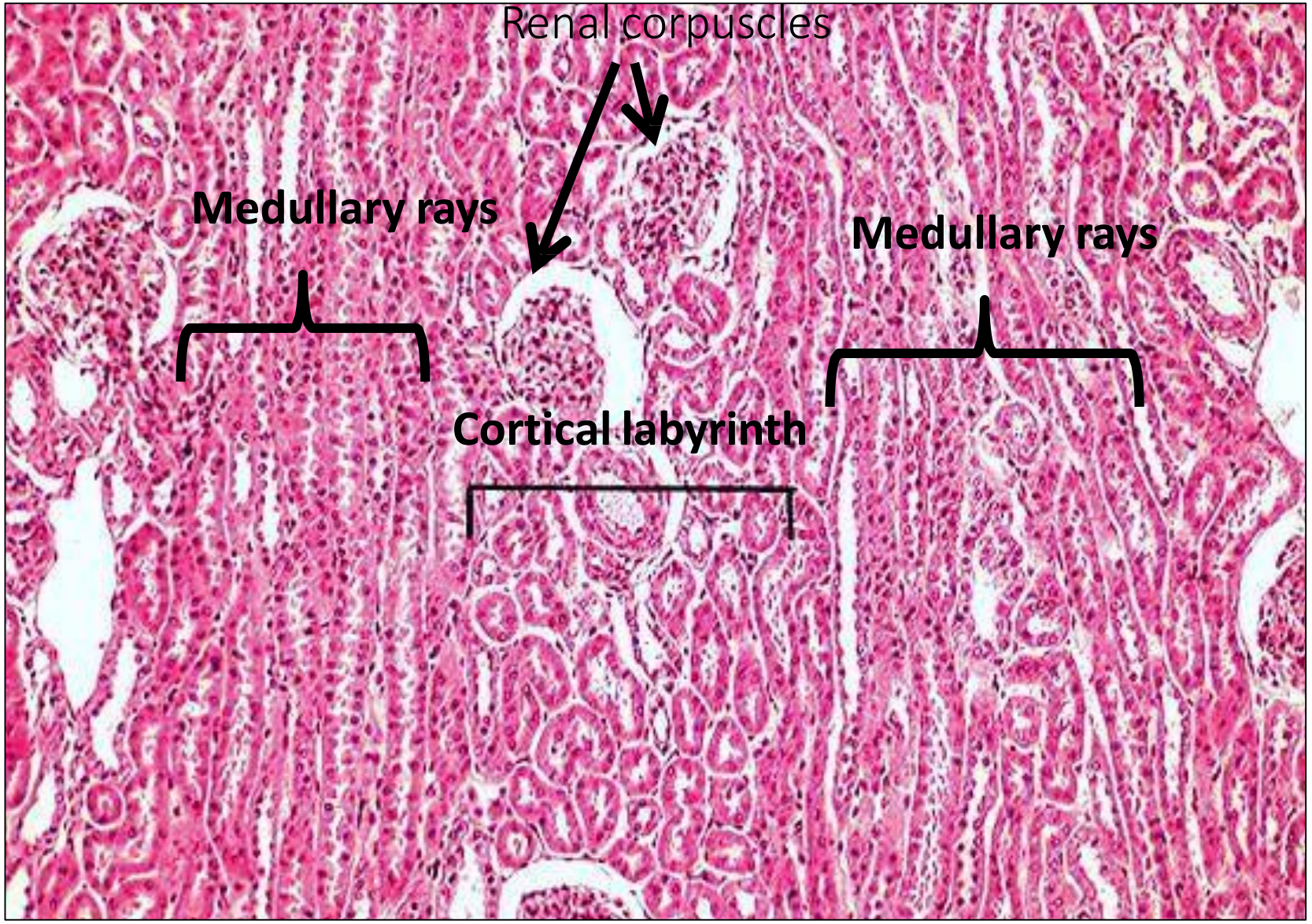


The renal medulla

- It is composed of 8-12 ***renal pyramids***:
  - ➢ Their bases: form the cortico-medulla junction.
  - ➢ Their apices (***the renal papillae***): protrude into the minor calyces.
- The tip of the papilla is perforated by the openings of the larger collecting ducts and so, it is called ***the area cribrosa***.






Renal corpuscles
Medullary rays
Medullary rays
Cortical labyrinth

The apex of each pyramid is called renal papillae .

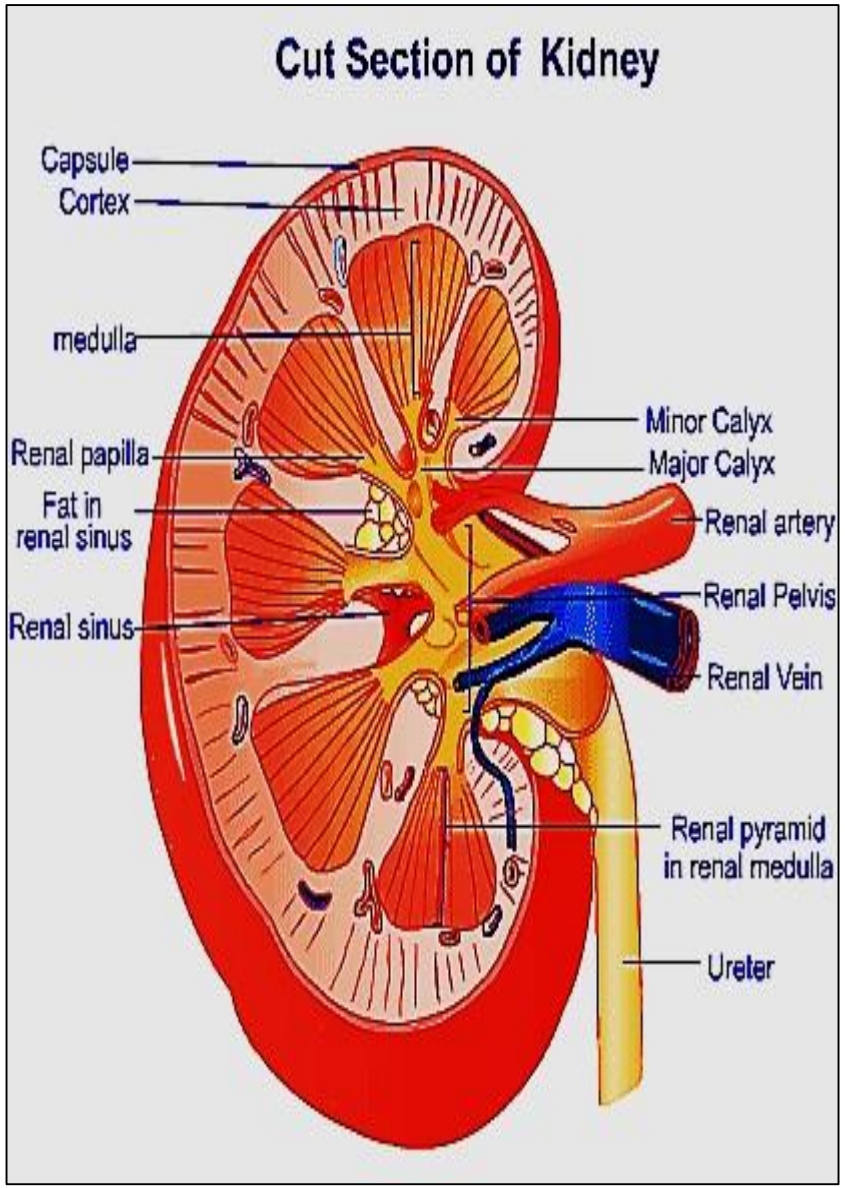
The renal papillae

projects into a **minor calyx**

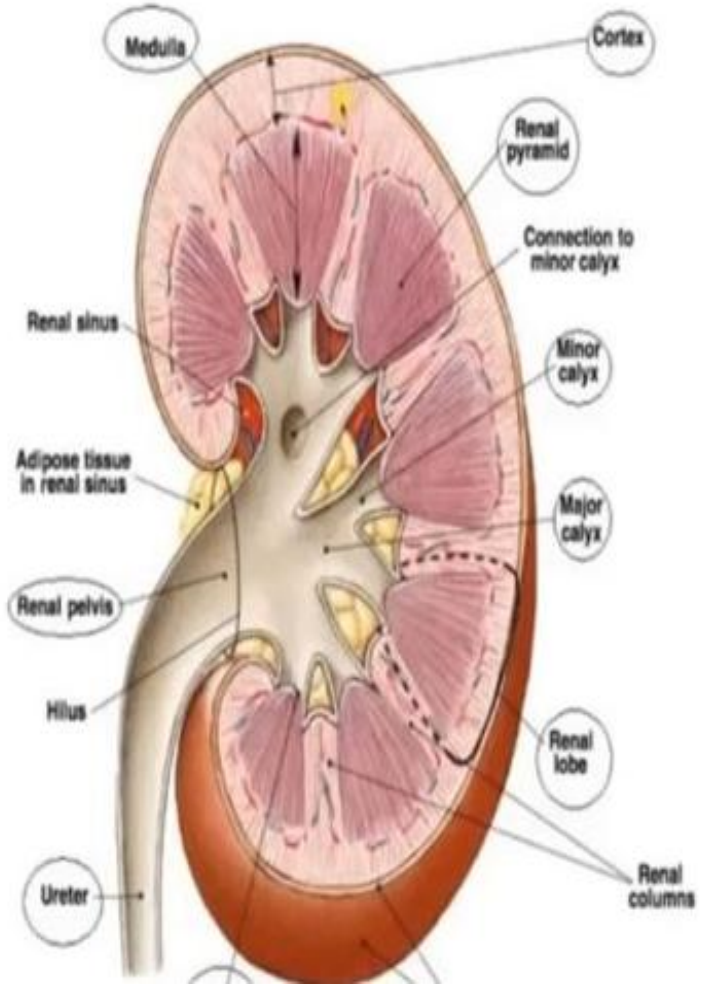
minor calyces join to 3-4

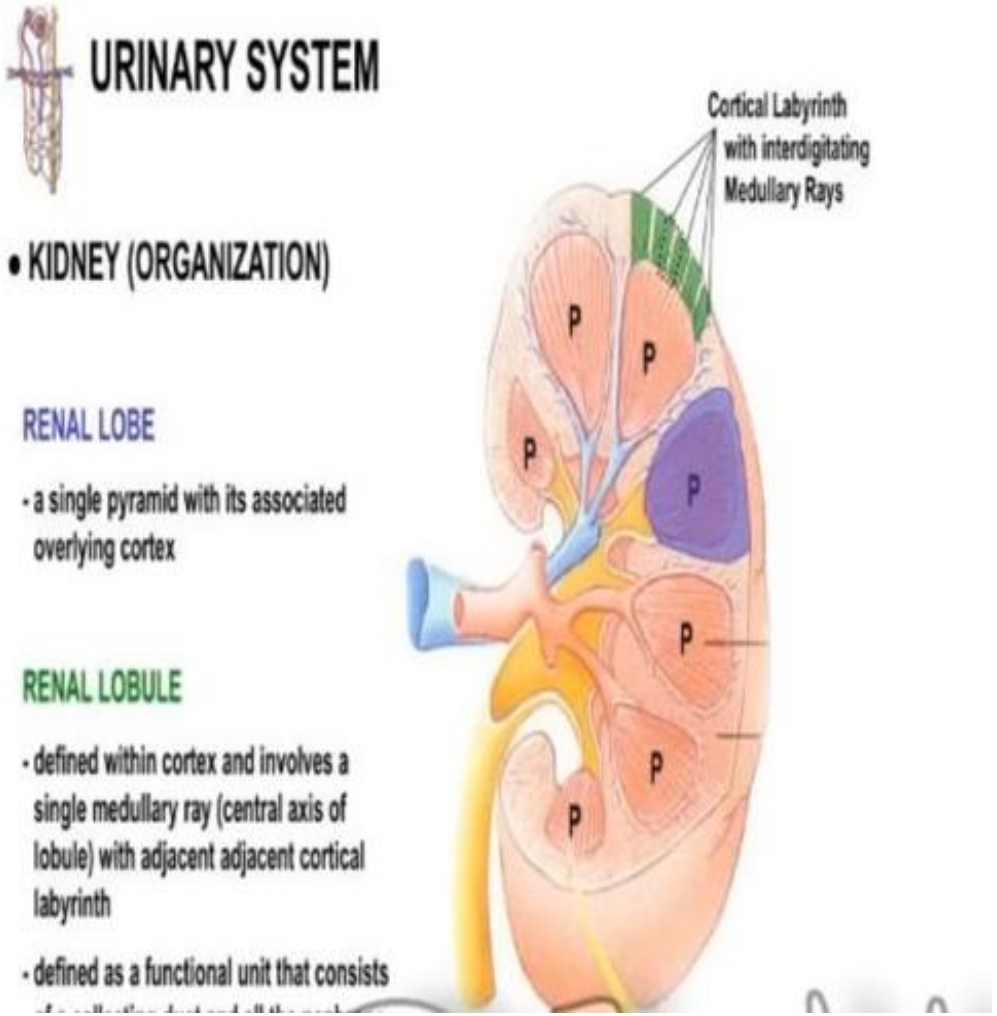
form a **major calyx**, which

empty into **renal pelvis**

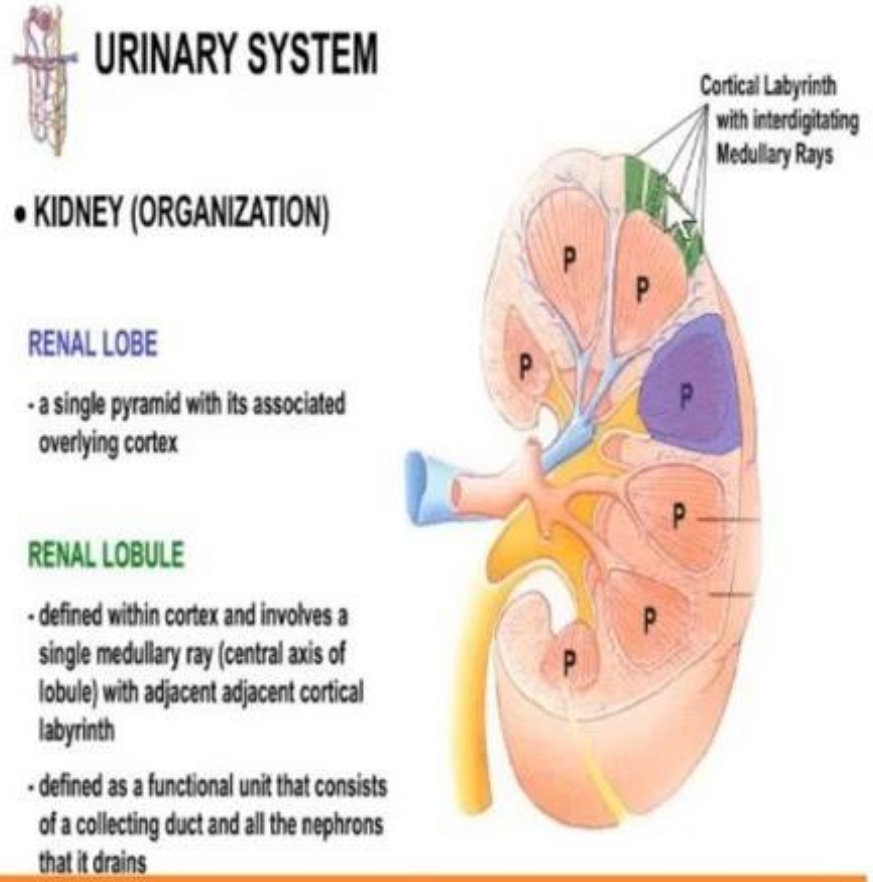


Renal lobe: medullary pyramid+ mass of cortical tissues surrounding it at the base and sides (½ of adjacent renal columns).





Renal lobule: medullar ray+ mass of cortical tissue surrounding it.



A collecting duct with all nephrons drain in it

URINARY SYSTEM

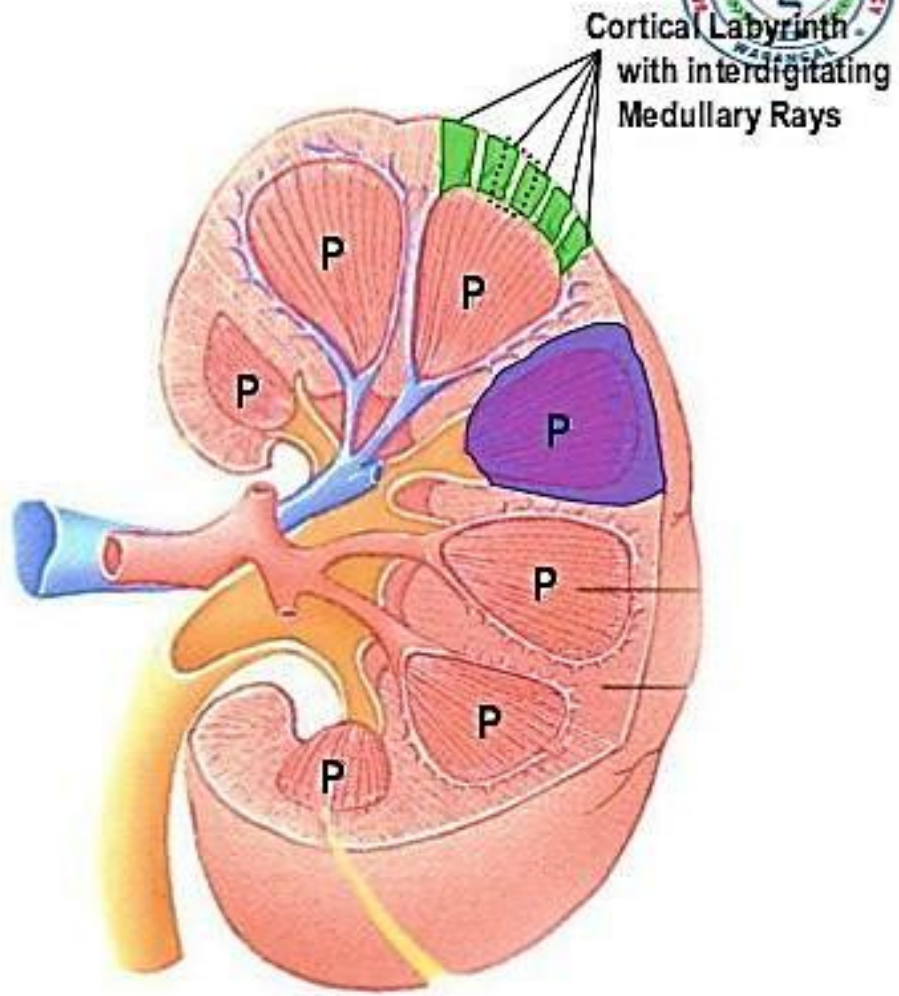
- **KIDNEY (ORGANIZATION)**

RENAL LOBE

- a single pyramid with its associated overlying cortex

RENAL LOBULE

- defined within cortex and involves a single medullary ray (central axis of lobule) with adjacent adjacent cortical labyrinth
- defined as a functional unit that consists of a collecting duct and all the nephrons that it drains

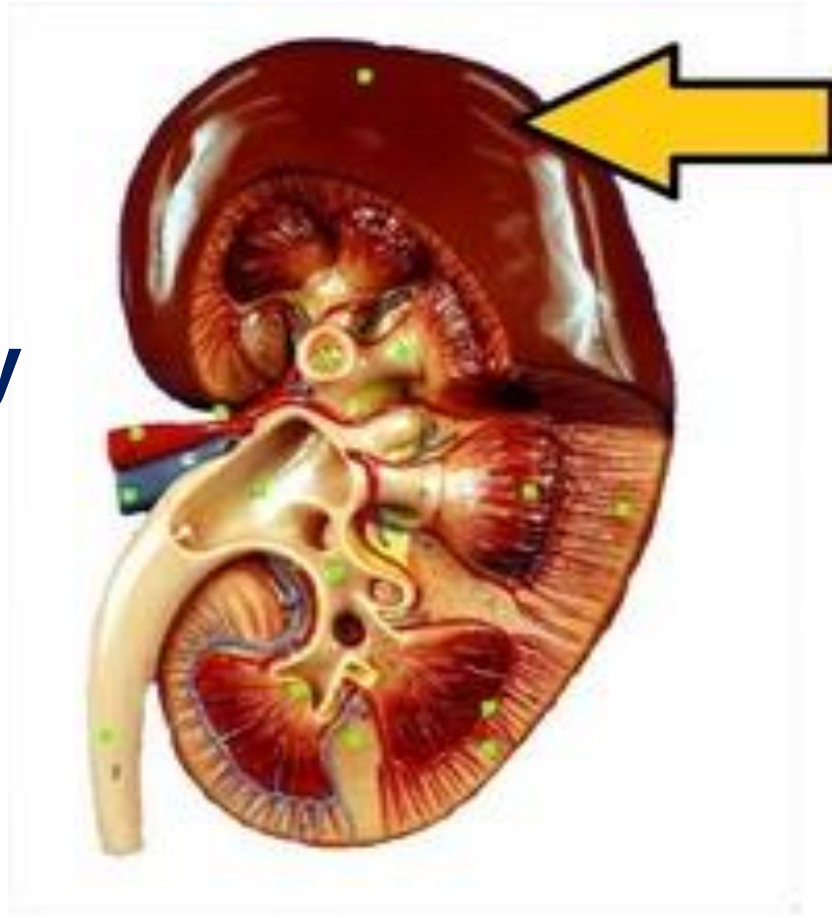


Histological Structure of The kidney:

1. Stroma
2. Parenchyma

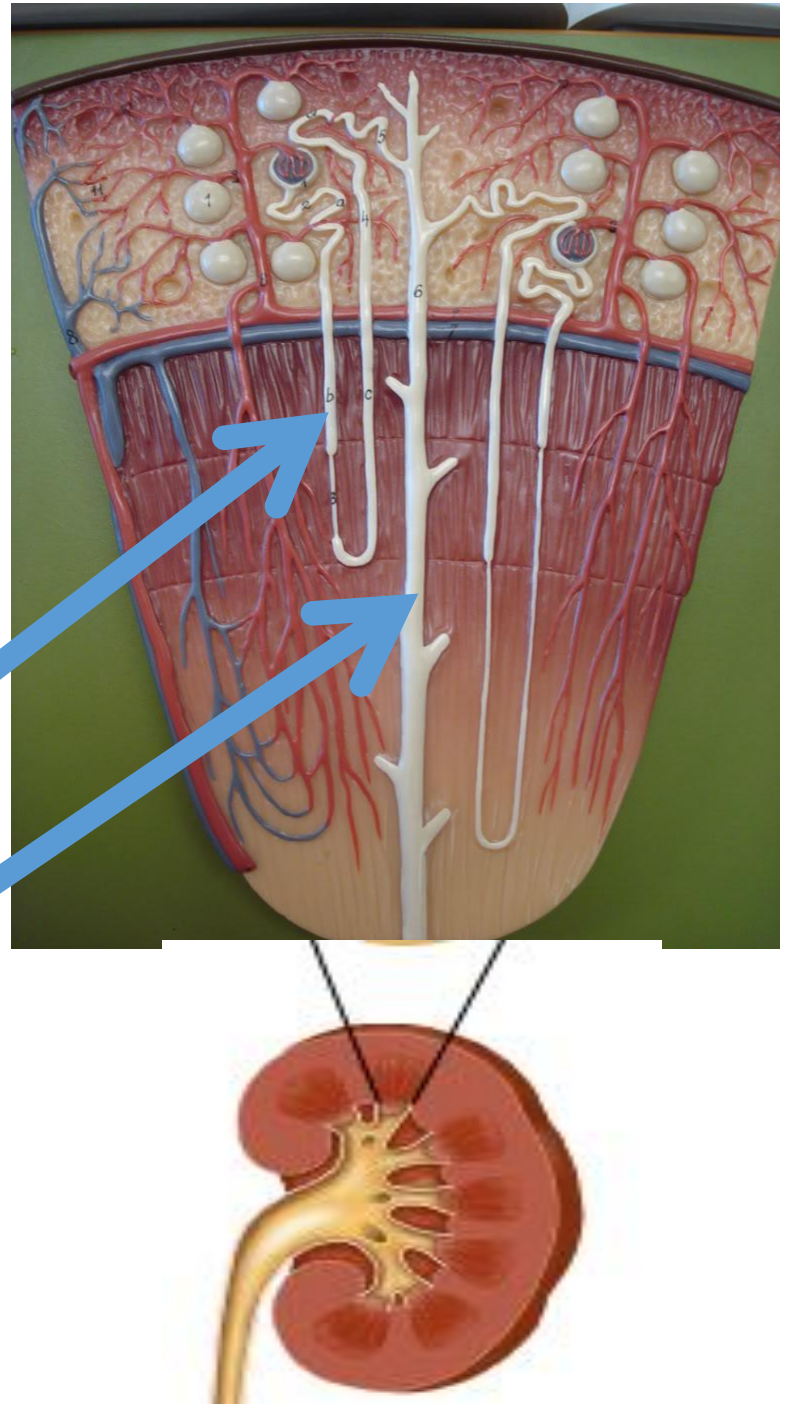
1. Stroma

- Capsule (Fibrous C.T.): Surrounded by peri-renal fat.
- Reticular stroma



2-The parenchyma of The kidney is formed of:

- **Uriniferous tubule:**
  - **The Kidney structural &functional unit.**
  - **Consists of nephron+ collecting tubule.**

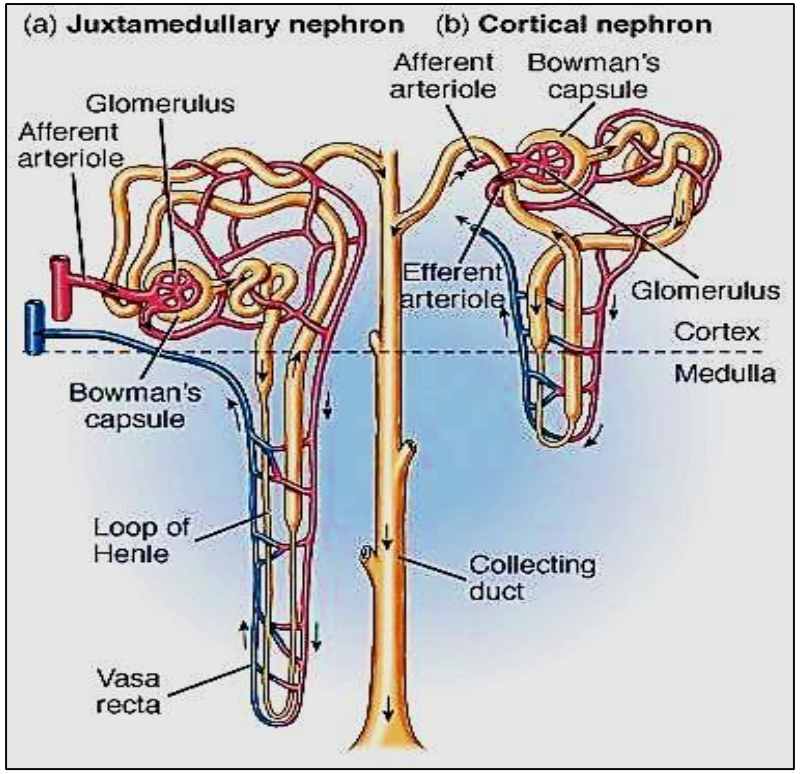


:Classification of nephrons

Cortical nephrons: 85%, short loop of Henle, extend close ➢ to cortico-medullary junction

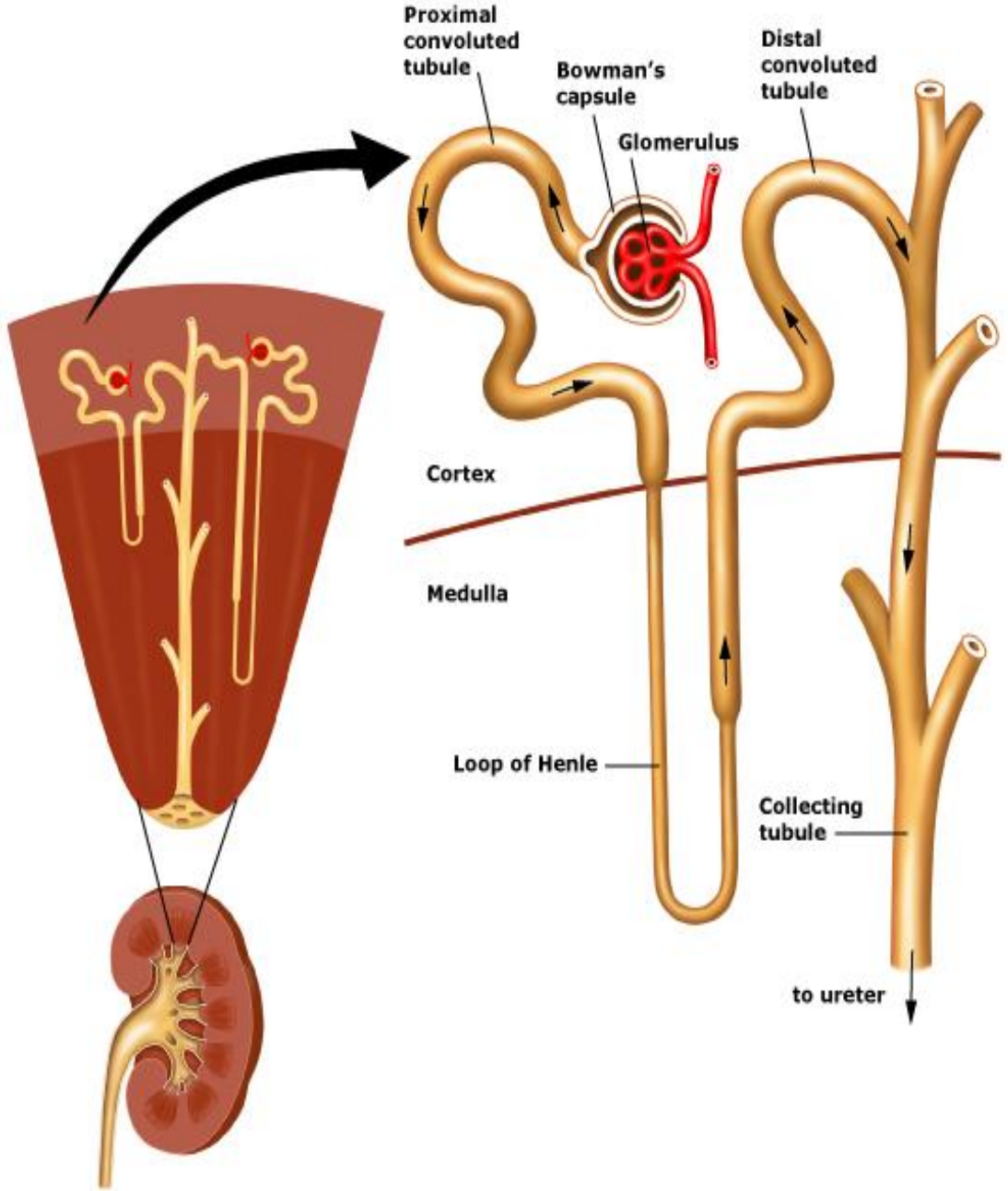
Juxta-medullary nephron: has long Loop of Henle, extend ➢ deep in the medulla

They are responsible for setting up medullary osmotic gradient production of concentrated → hypertonic urine



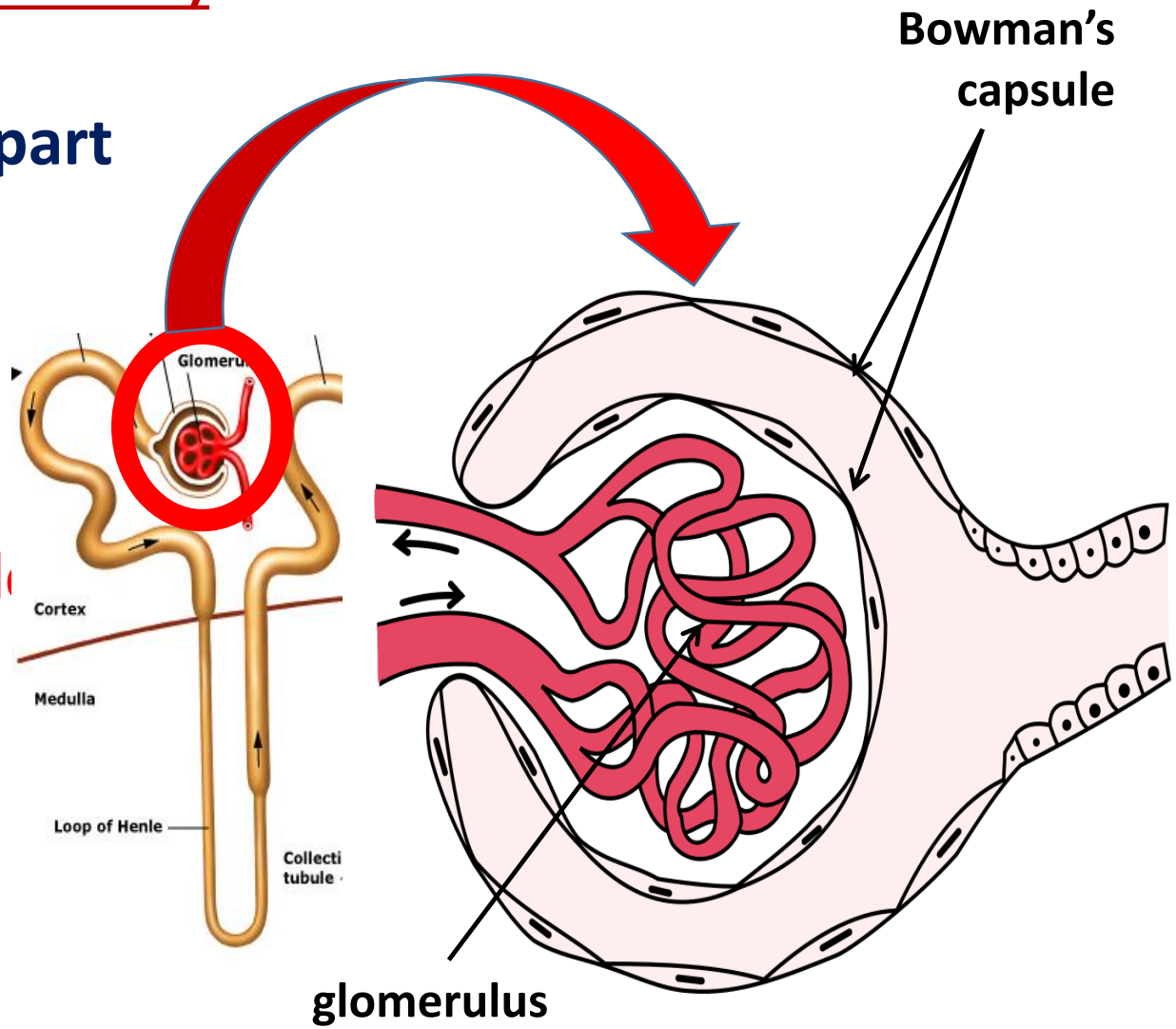
- **The Nephron:**
- The active part (The structural Unit of the Kidney)
- Subdivided into:

1. Renal corpuscle.
2. Proximal convoluted tubule (P.C.T.).
3. Loop of Henle.
4. Distal convoluted tubule (D.C.T.).



1- The Renal Corpuscle (Malpighian Corpuscle)

- The most active part of the nephron.
- 150-250 µm in diameter.
- Formed of:
  Bowman's capsul
  glomerulus



A-Bowman's Capsule:

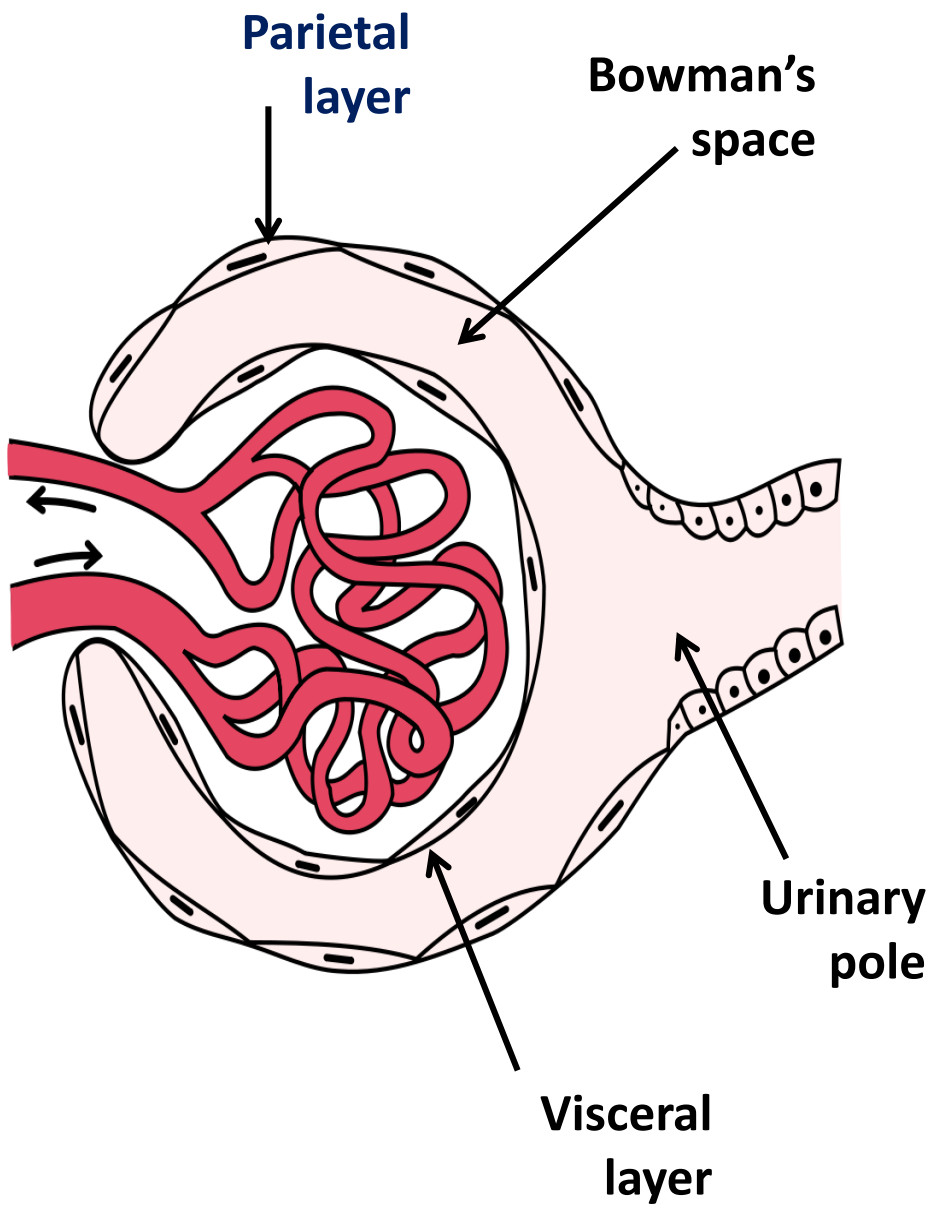
- A double layered & cup-shaped.
- The 2 layers, separated by capsular space.

1. Parietal layer (outer) (capsular epithelium): Simple squamous epithelium.
2. Visceral layer(inner) (glomerular epithelium): Podocytes.

- has 2 poles:

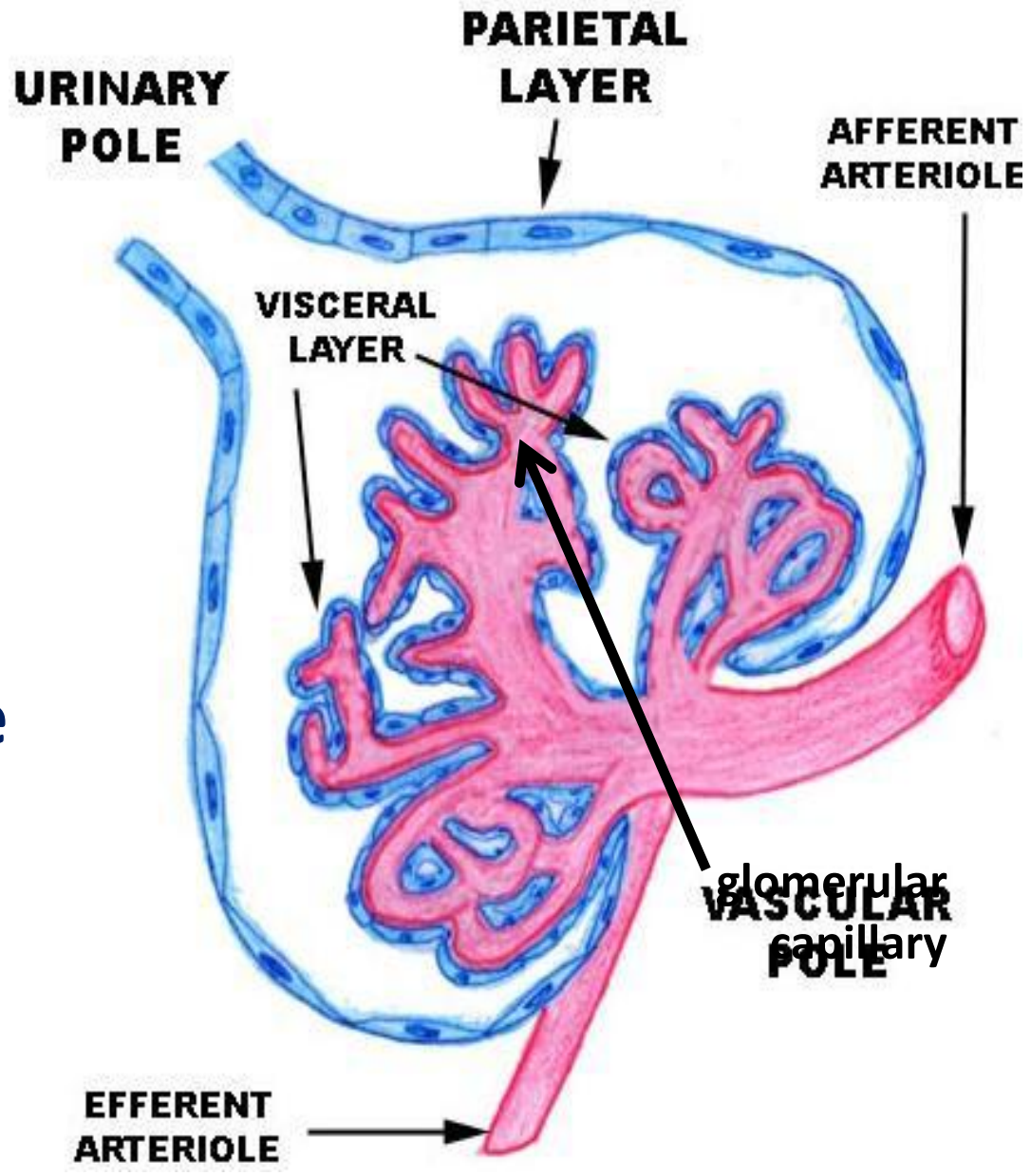
1. Vascular :invaginated by capillary tuft

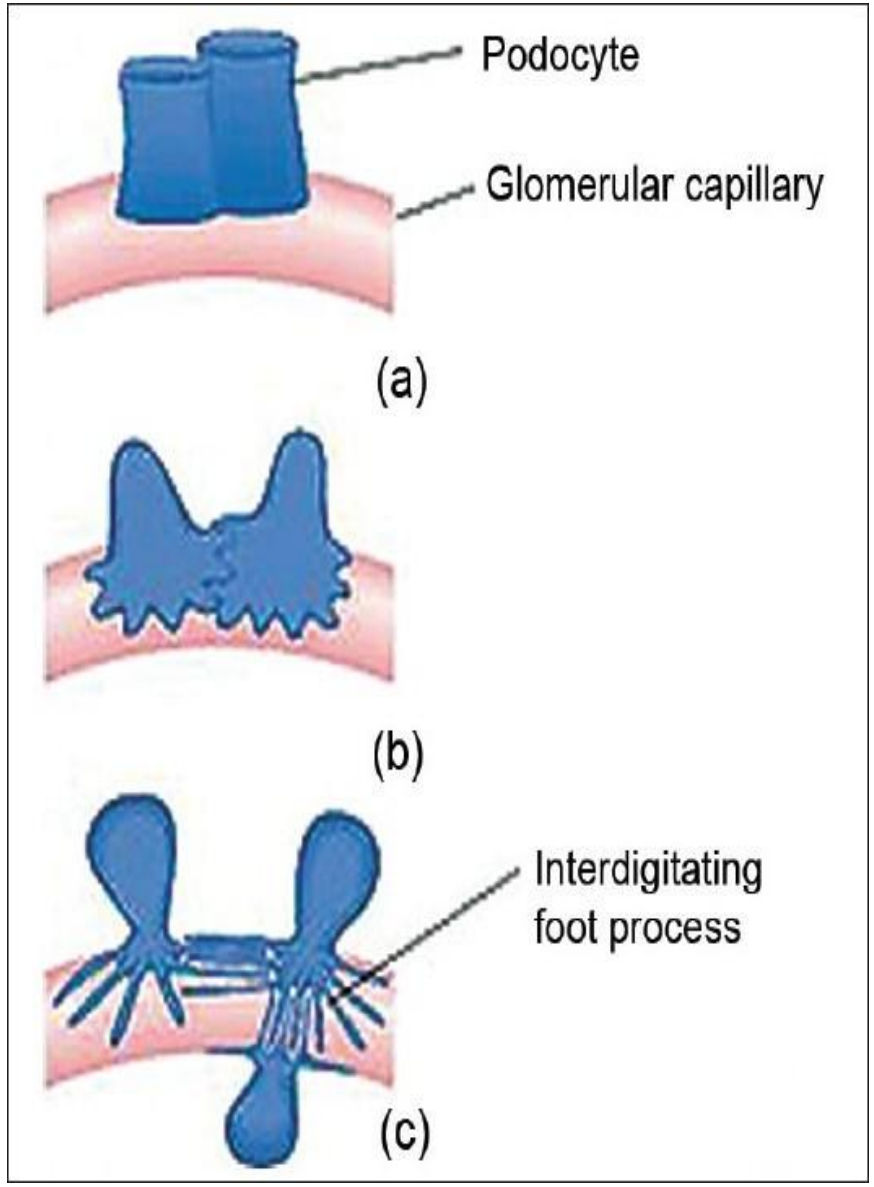
2. Urinary : connected to P.C.T.



Podocytes:

- Visceral layer of Bowman's capsule
- Large flattened modified epithelial cells with oval nucle

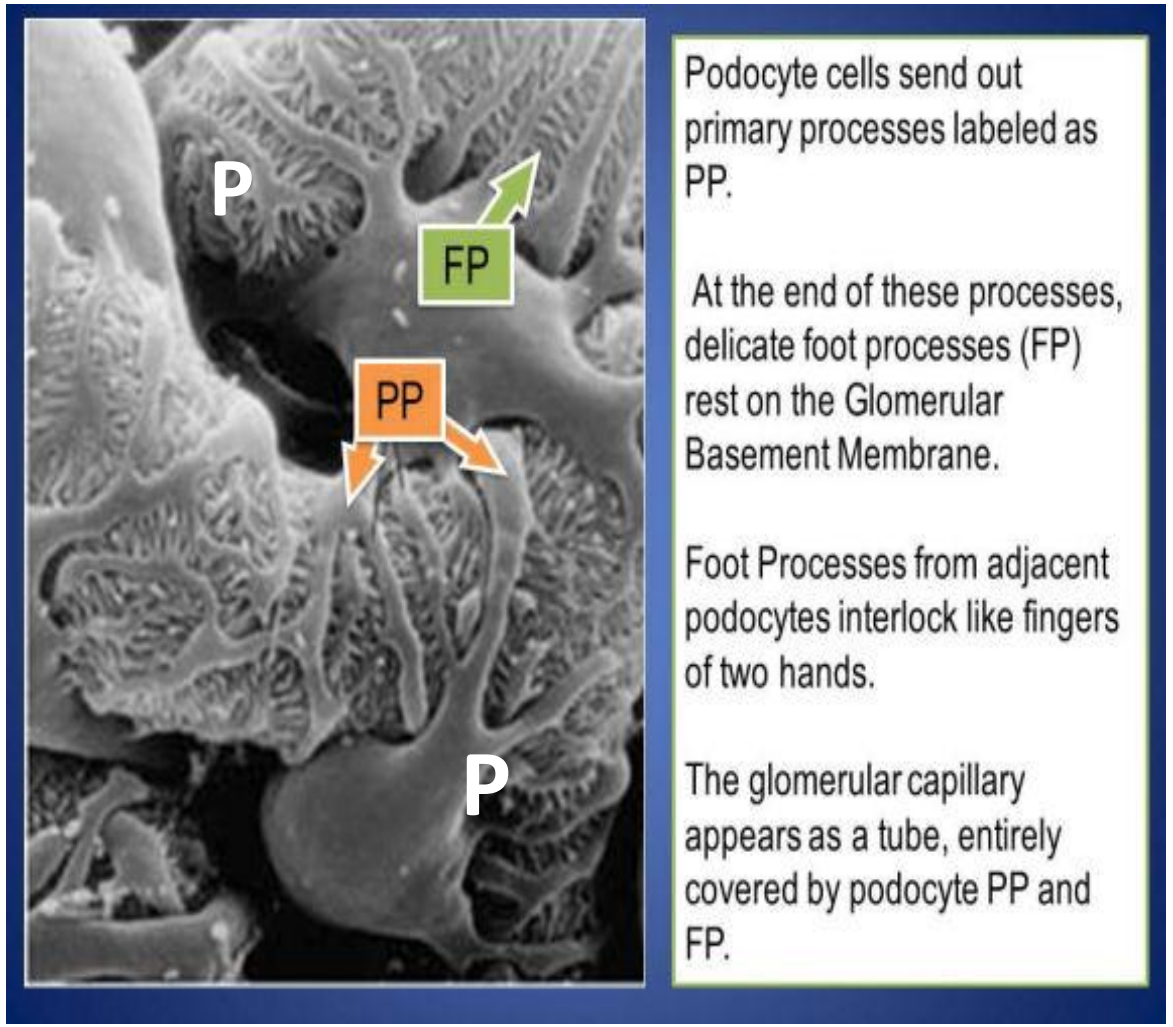




A theoretical model of podocyte maturation and foot process

- **Podocytes:**

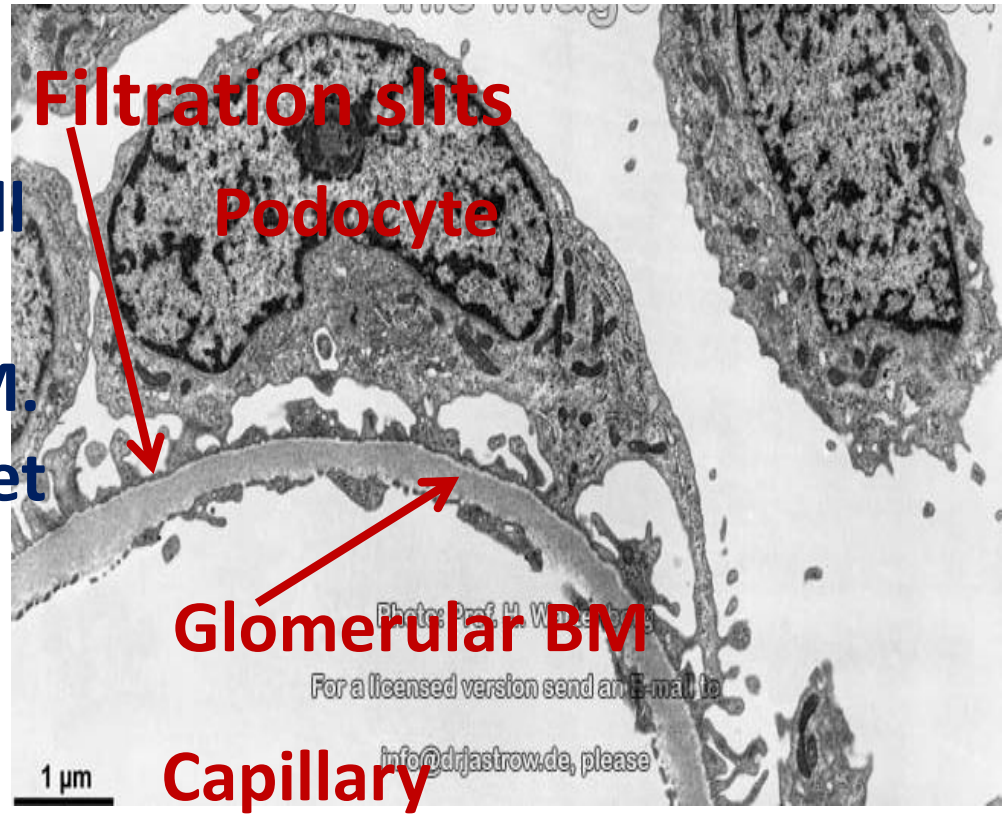
➢ **Major processes extend from the cell body parallel to the wall of glomerular capillary.**



P= Podocyte

➢ **Minor processes** arise from the deep surface of cell body & major processes. They reach the capillary B.M. where they terminate by feet like structures.

➢ **Filtration slits**: minute gaps (about 30 nm) between the feet like structures of the minor processes. They are covered with diaphragms.

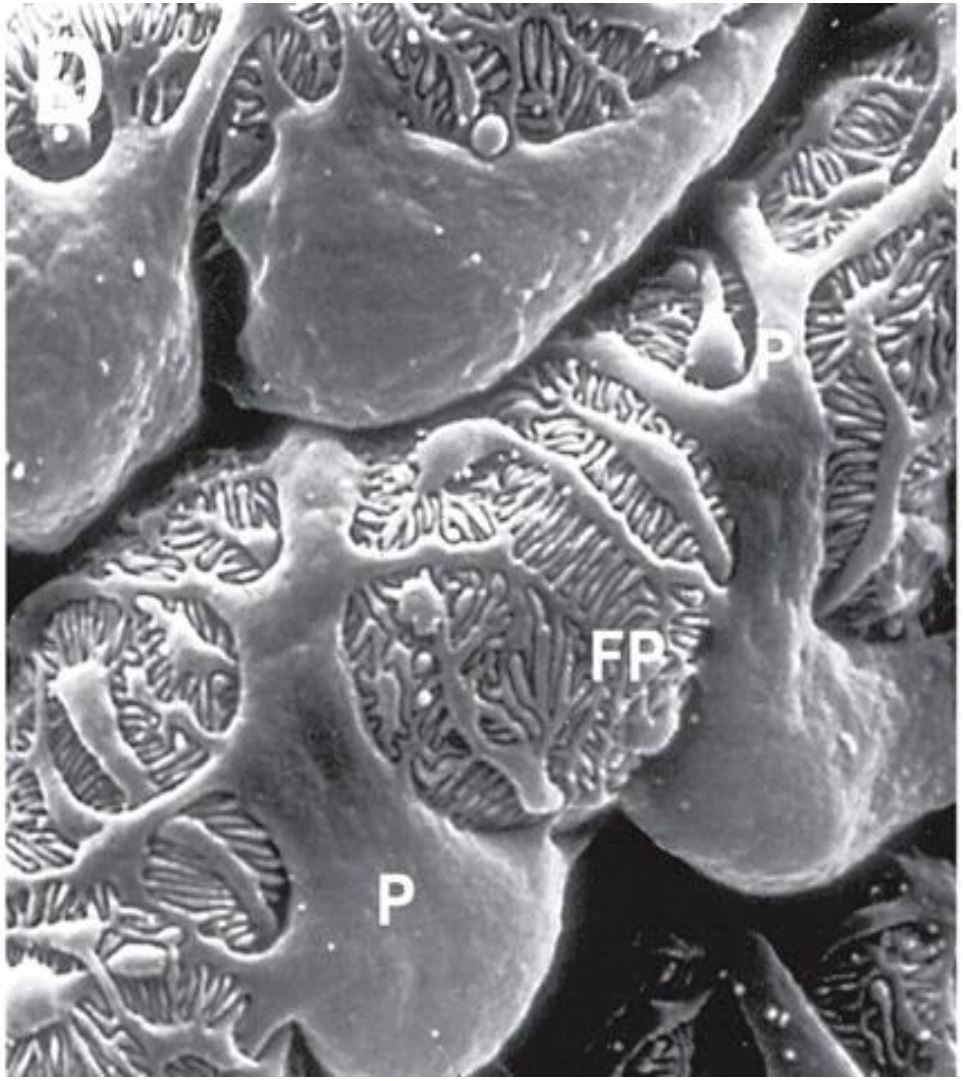


Podocytes are Separated from B.M. of glomerular capillary by subpodocytic space.

➢**Function of podocytes:**

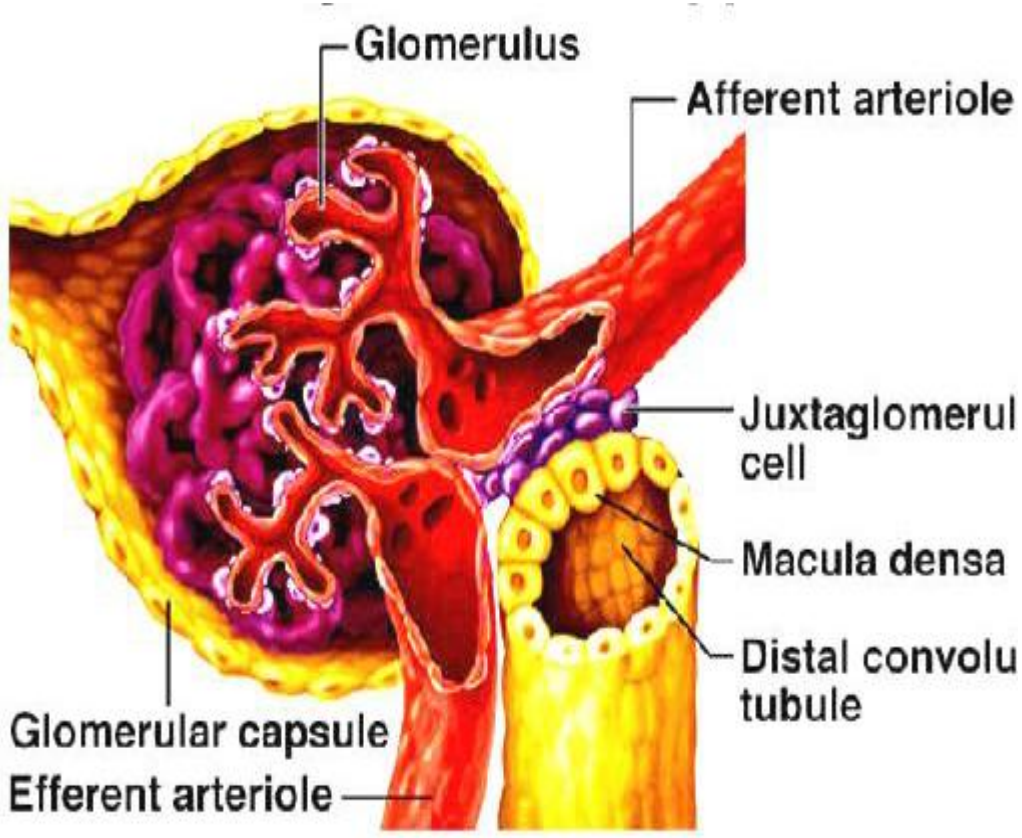
1. Synthesis of glomerular basement membrane.

2. Share in the formation of *blood-renal barrier*



B- The Glomerulus:

- **Tuft of capillaries, formed of about 50 tortuous cap. Loops arising from the afferent arteriole at the vascular pole (non-filtered blood) & drain into the efferent Arteriole (filtered blood).**



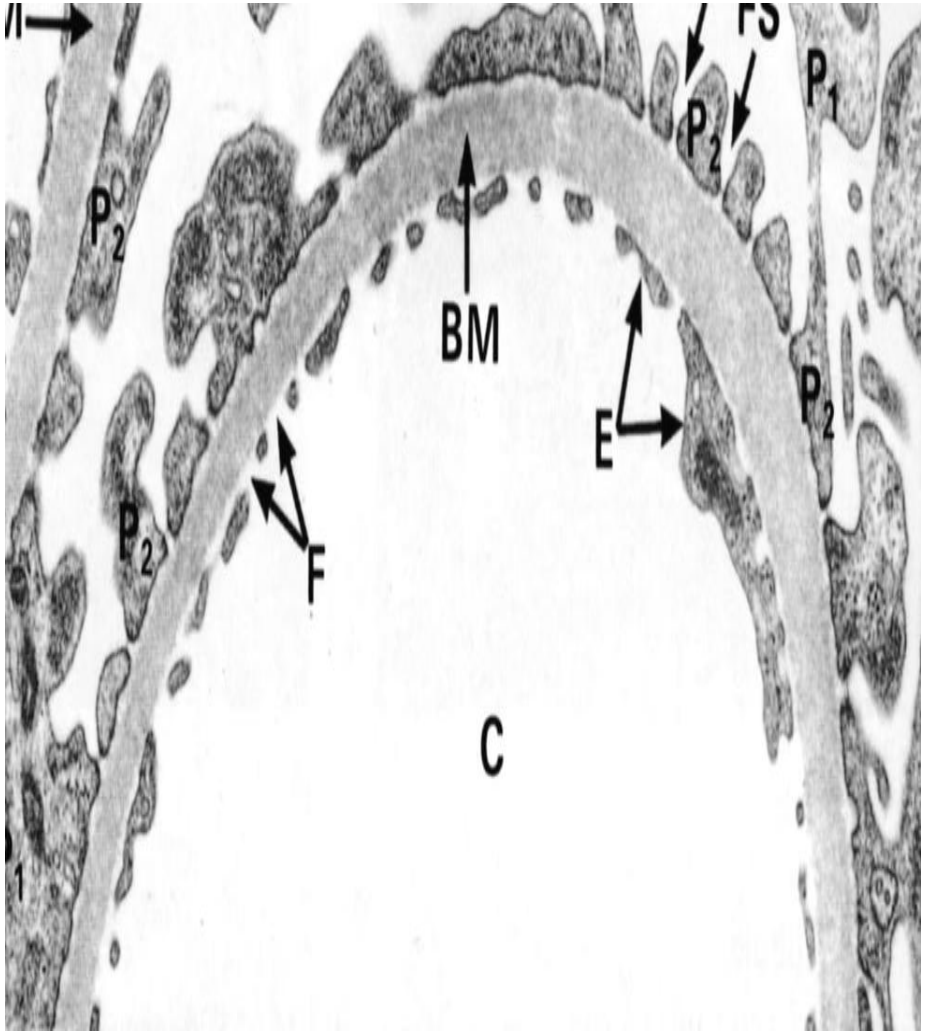
- By EM: The wall of the glomerular capillary is formed of:

1. Fenestrated endothelium interrupted by pores about 60-100 nm.

2. Thick basement membrane (B.M.).

- Formed by fusion of 2 membranes (BM of podocyte & capillary).

- about 100 nm thick.



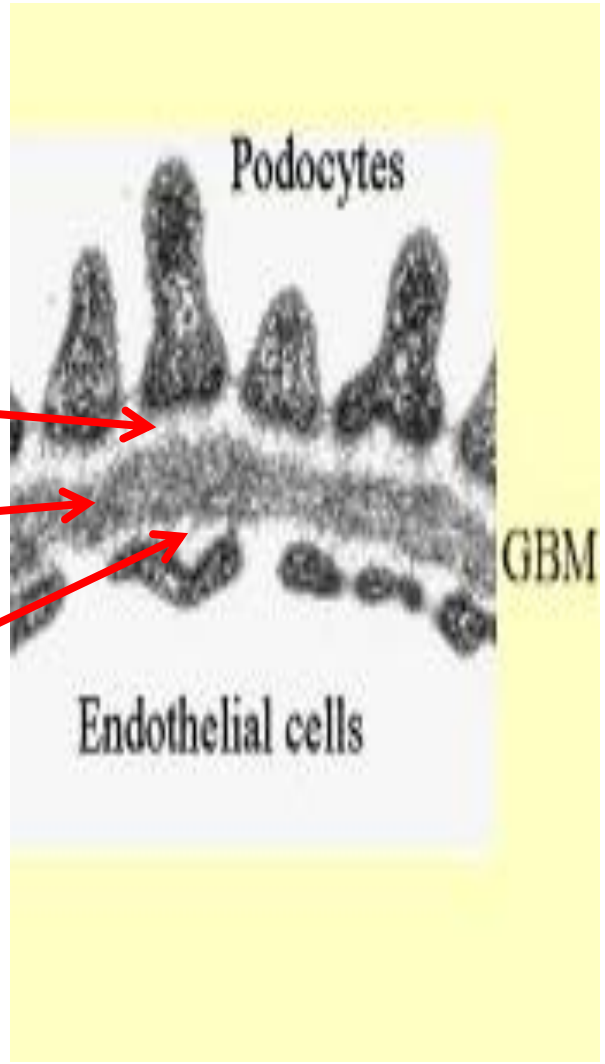
F= Fenestrae
BM= Glomerular Basement membrane
E= Endothelium
C= Capillary

Glomerular Basement **membrane shows 3 layers:**

1. Lamina Lucida externa (outer & pale).

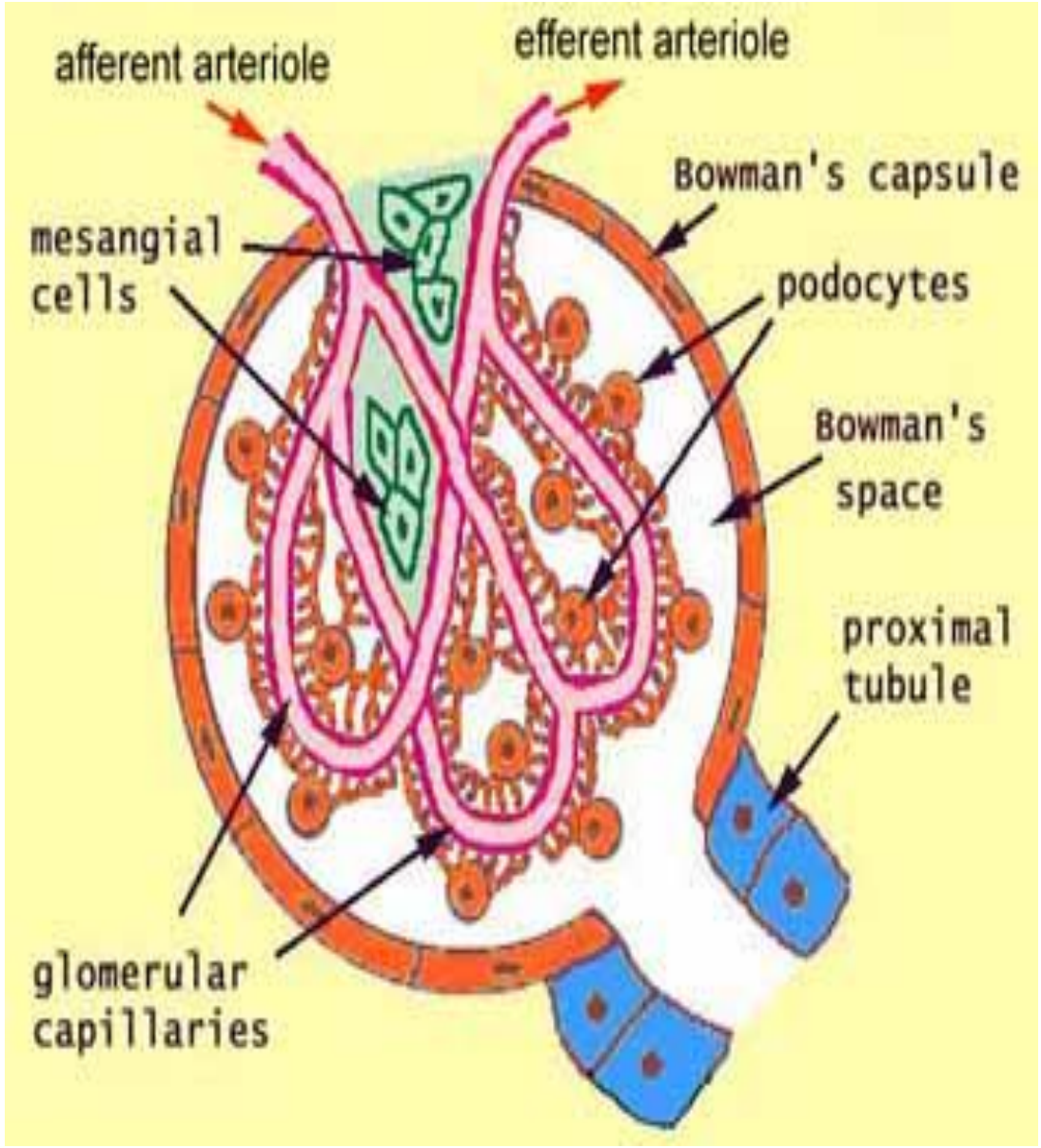
2.Lamina densa (central and dark).

3.Lamina Lucida interna (inner & pale).



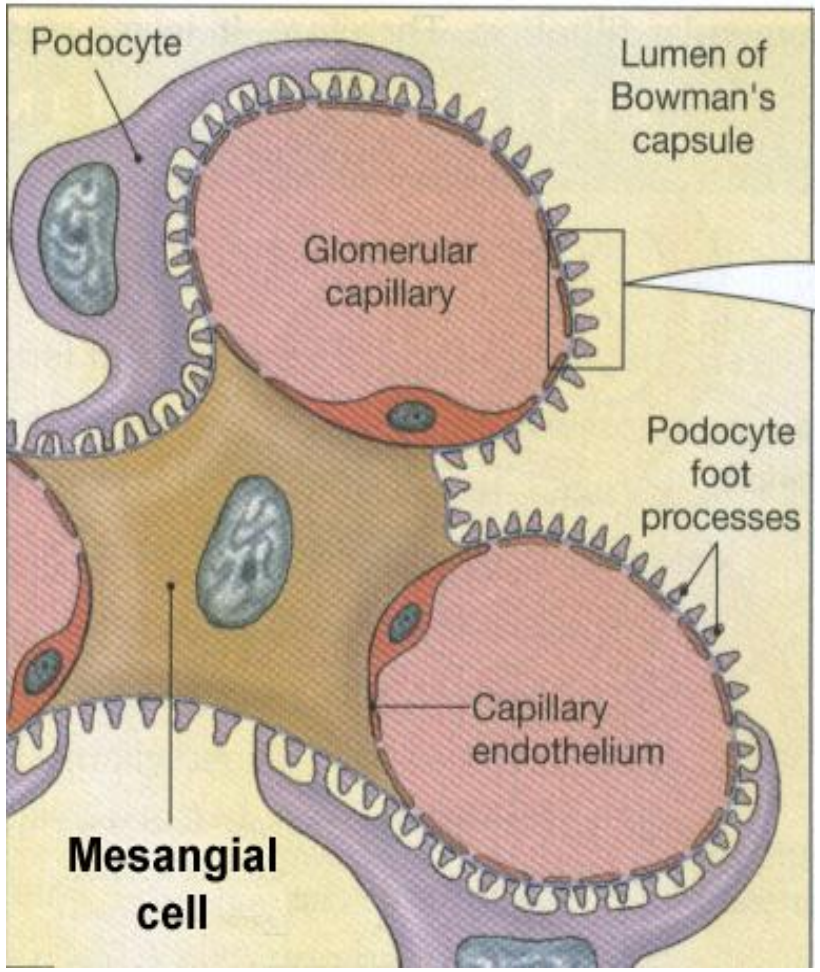
Mesangial cell:

- **Site: between glomerular bl cap.**
- **LM: stellate shape, with small dark nucleus & basophilic cytoplasm rich in lysosomes.**



Functions of Mesangial cell :

1. Turnover of BM by removal of old one from inside by phagocytosis.
2. Phagocytosis of FB.
3. Secrete collagen, and fibronectin, which provide support to glomerular BM.



The blood renal barrier (Filtration barrier):

- **Separates bl. in glomerular cap. from Bowman's space.**
- **Formed of:**

1. Glomerular endothelium: Holds back bl. cells.

2. The BM:

-Holds back plasma proteins.

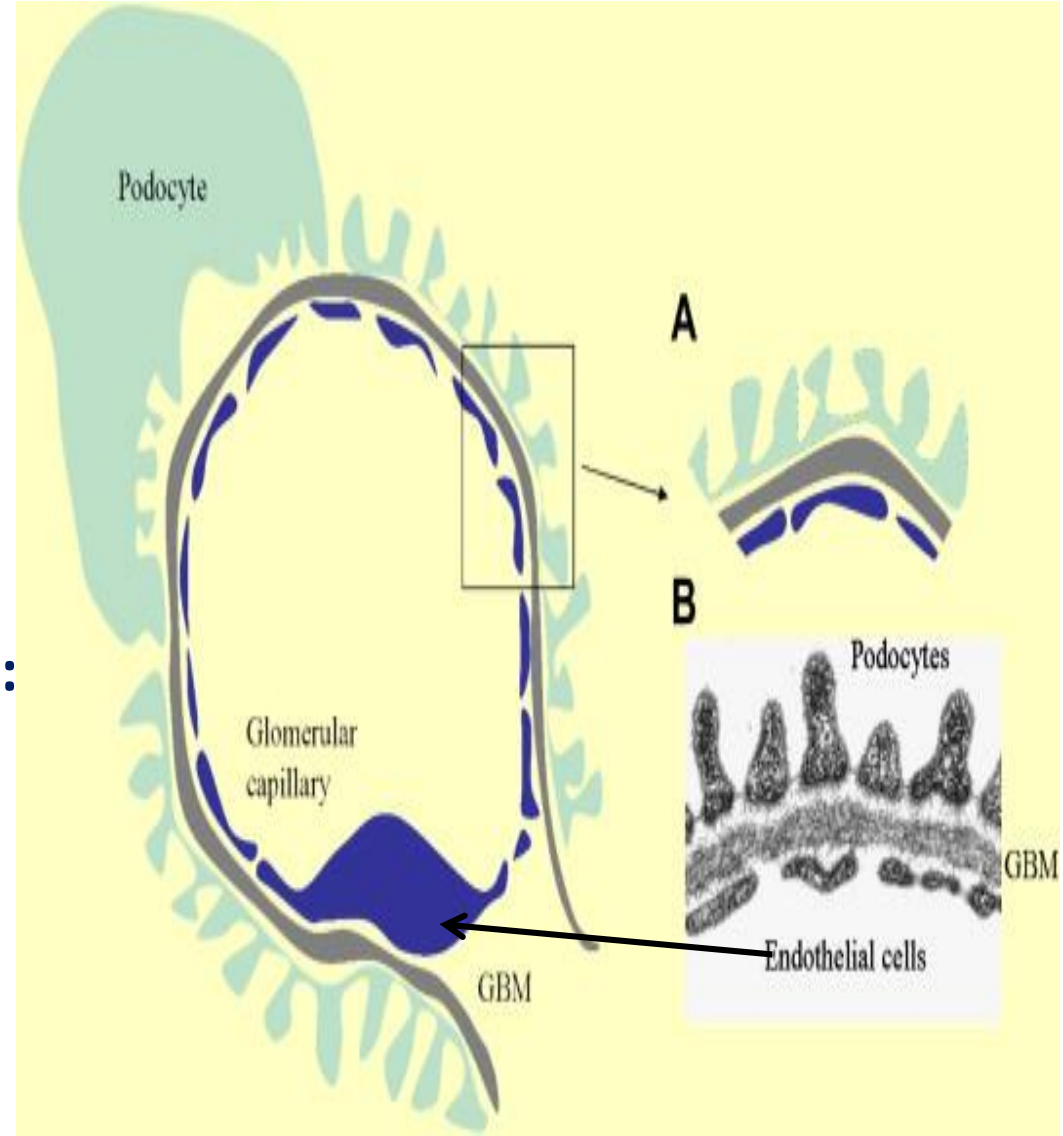
3. Filtration slit diaphragm:

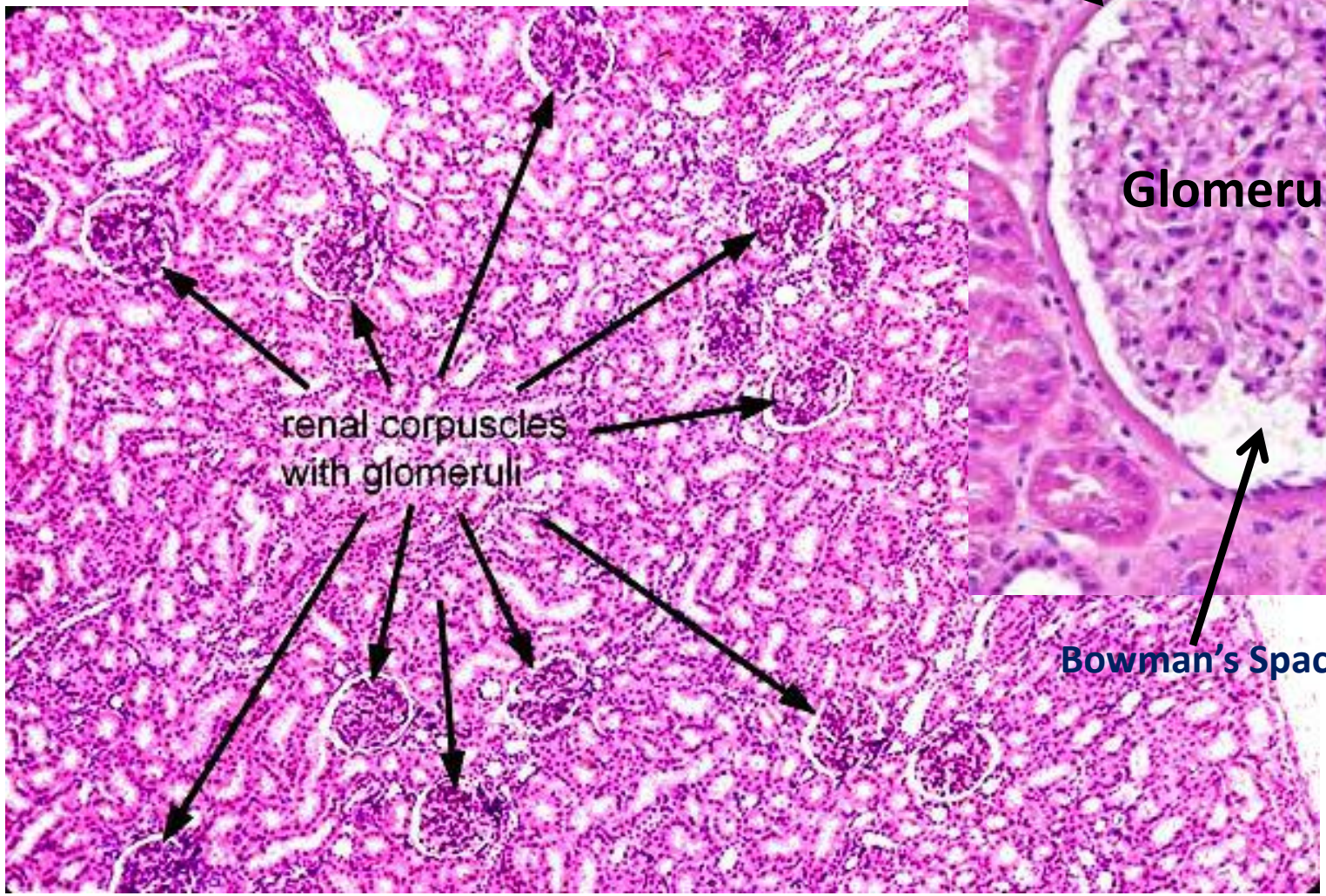
-covers filtration slits.

-Holds back large molecules.

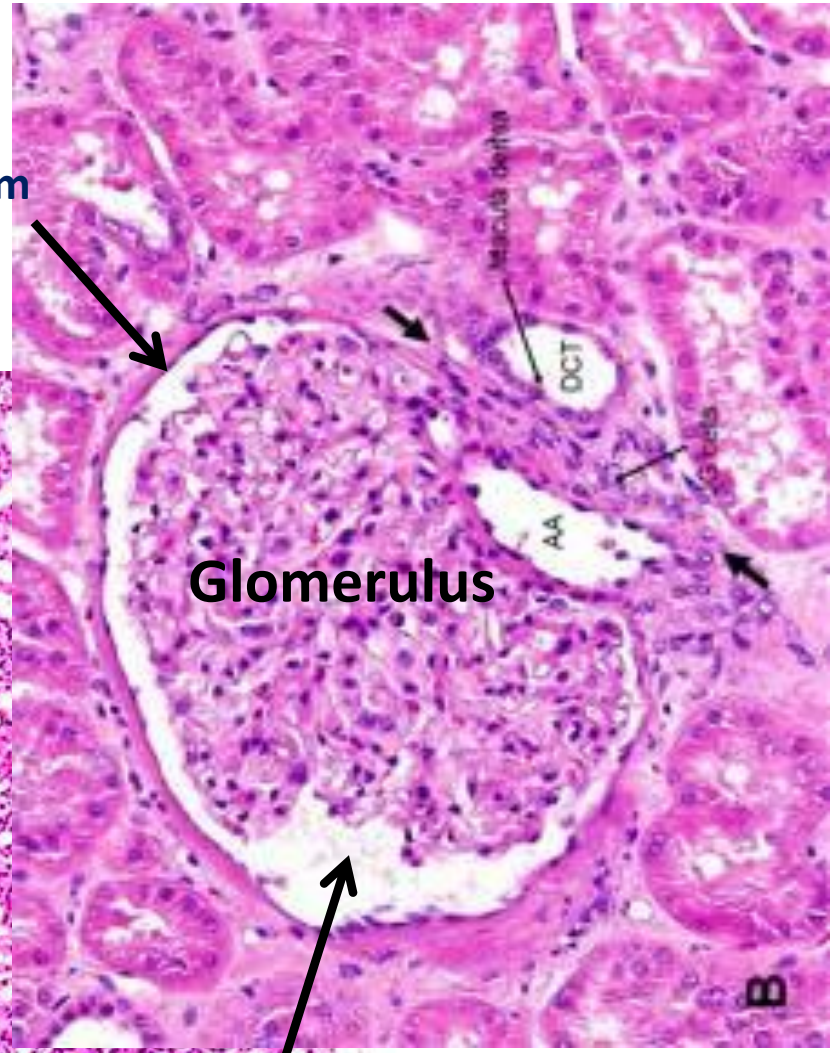
Functionof the filtration barrier:

Dialysis of blood plasma.

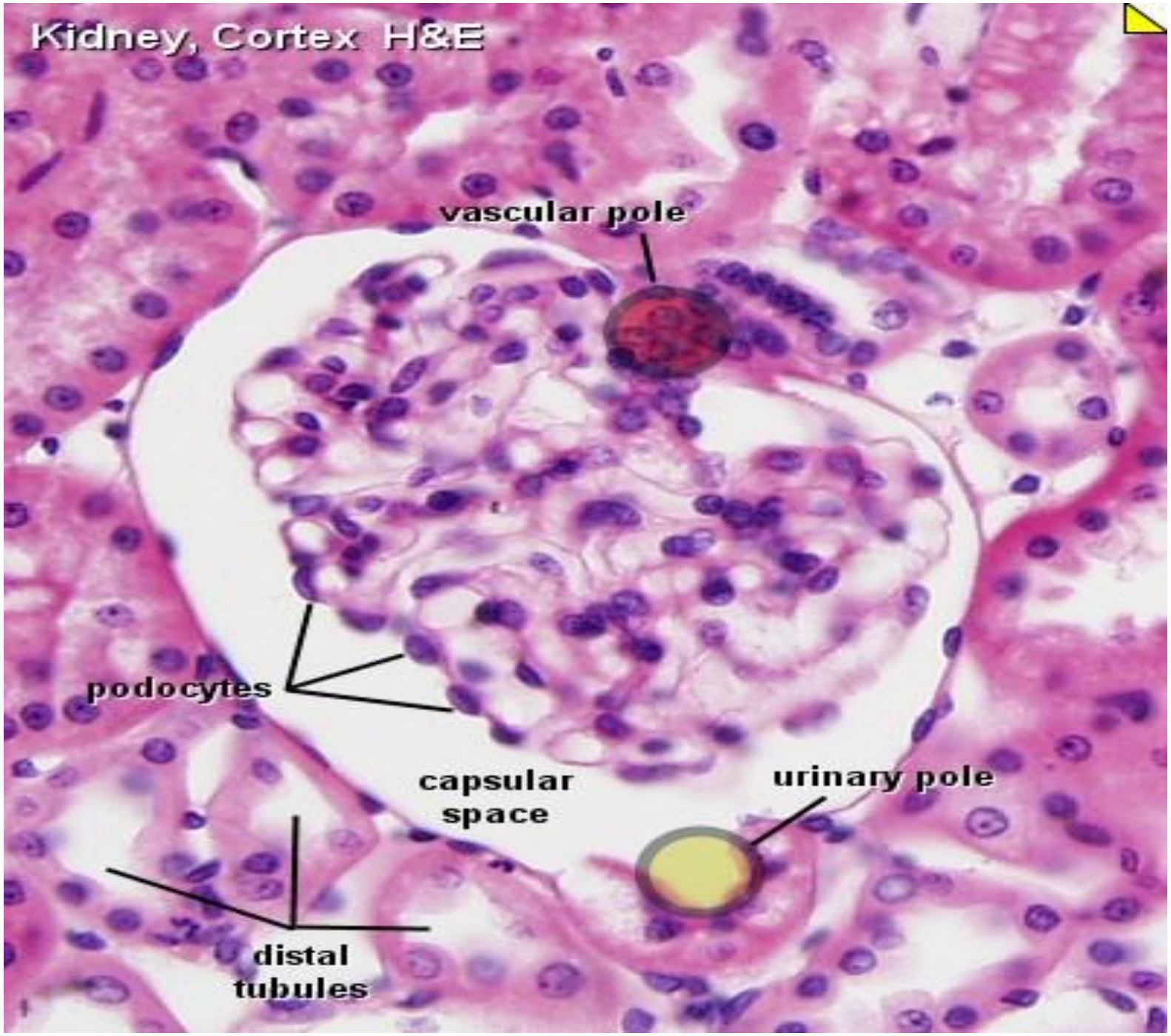




capsular epithelium



Bowman's Space


Kidney, Cortex H&E
vascular pole
podocytes
capsular space
urinary pole
distal tubules

THANK YOU