

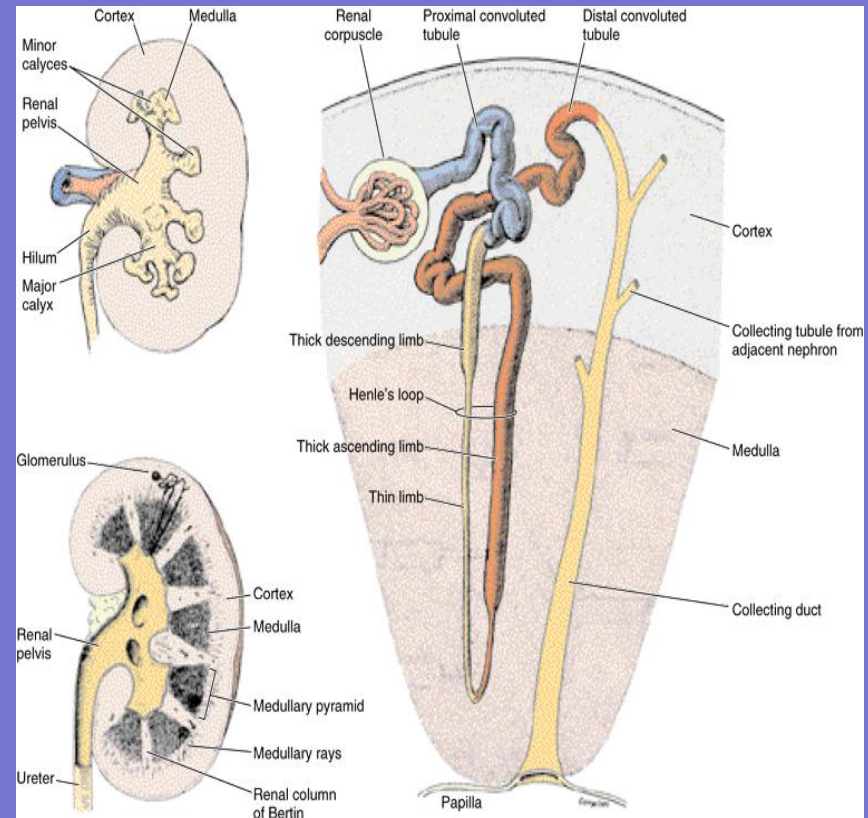
Urinary system

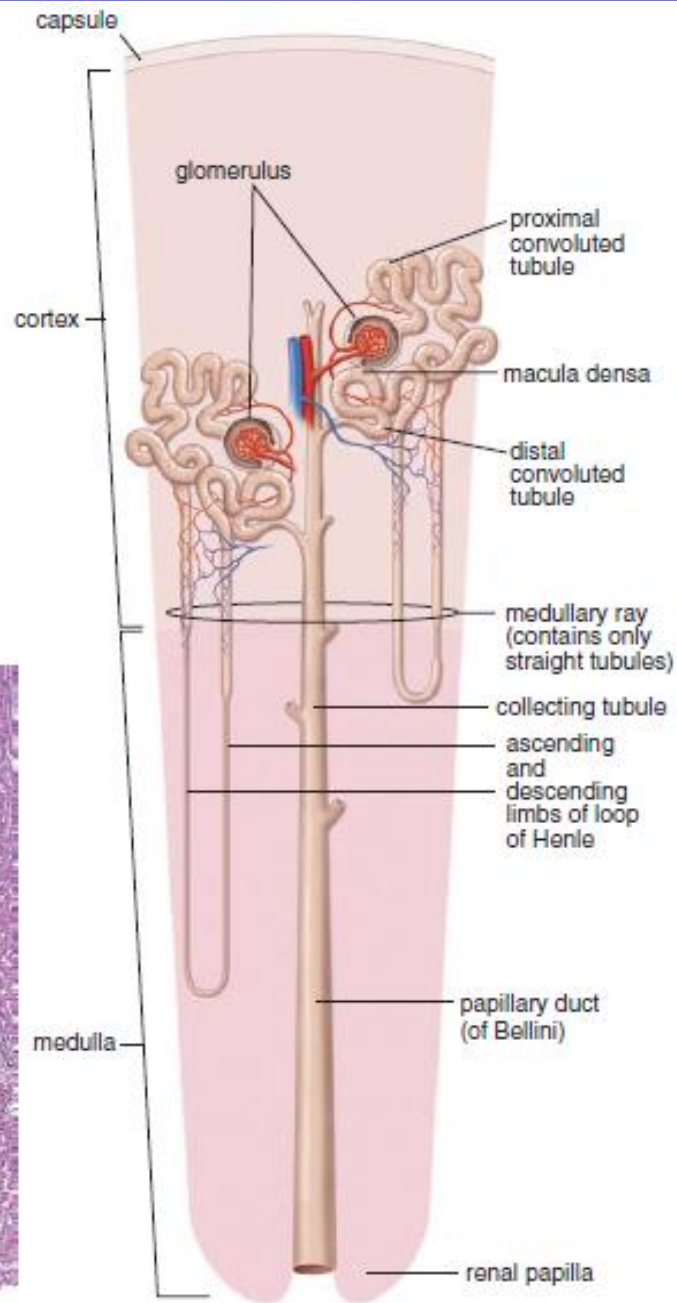
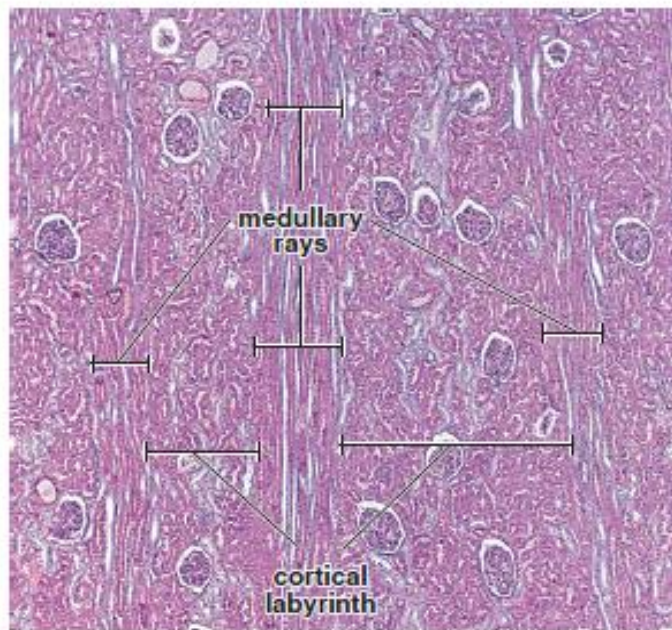
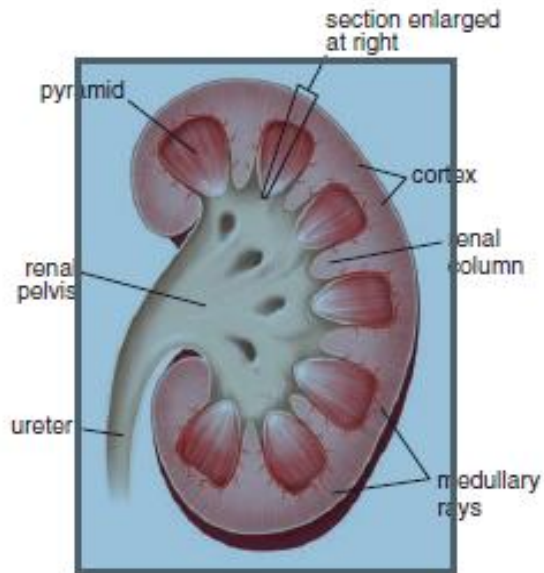
Urinary system

- **Consist from two kidneys and ureters , urinary bladder and urethra .**
- **It is responsible for maintenance of homeostasis .**
- **Regulate the fluid and electrolyte balance.**
- **Production of renin**
- **Production of erythropoietin**

Kidneys

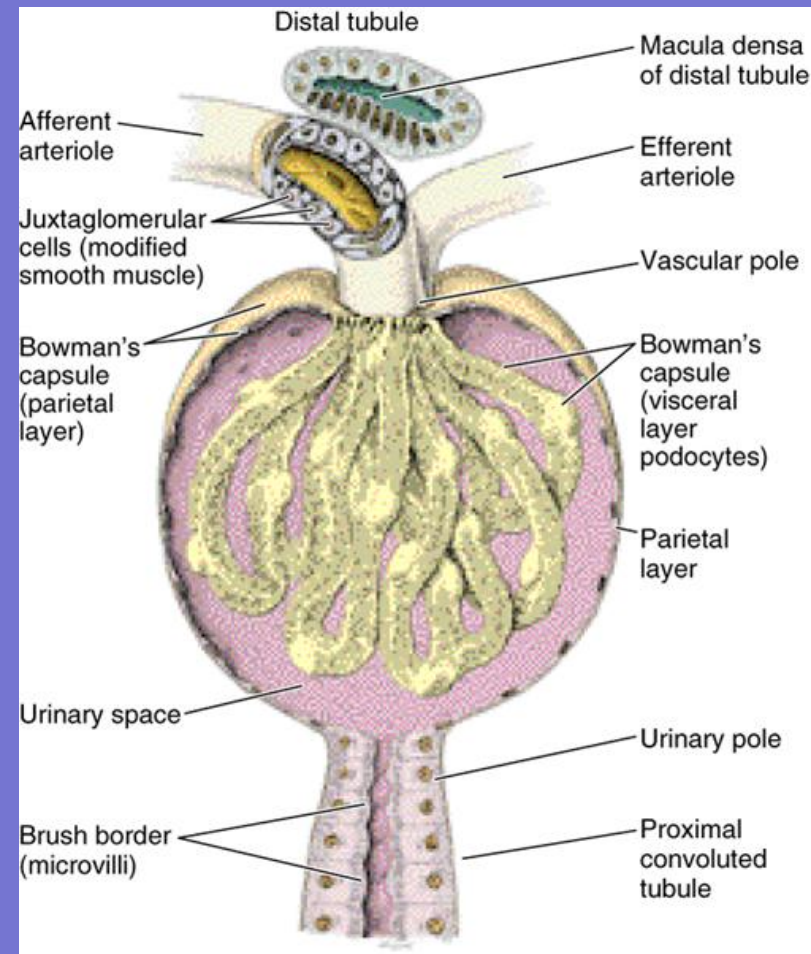
- Has two borders
- Can be divided into cortex and medulla
- Has renal pelvis ,major calyces ,minor calyces
- Composed from 1-2 millions of nephrons (renal corpuscle ,PCT,loop of Henle ,DCT ,C tubules and ducts .



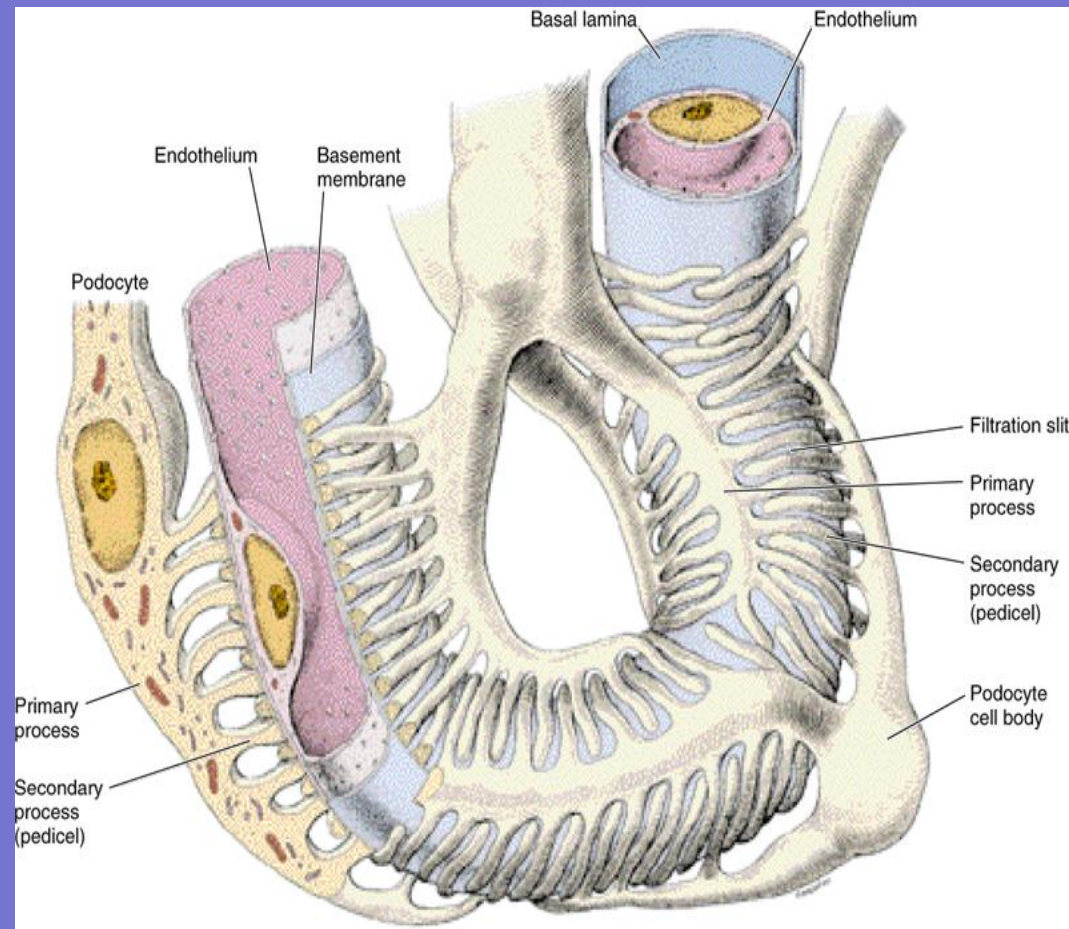


Renal corpuscle

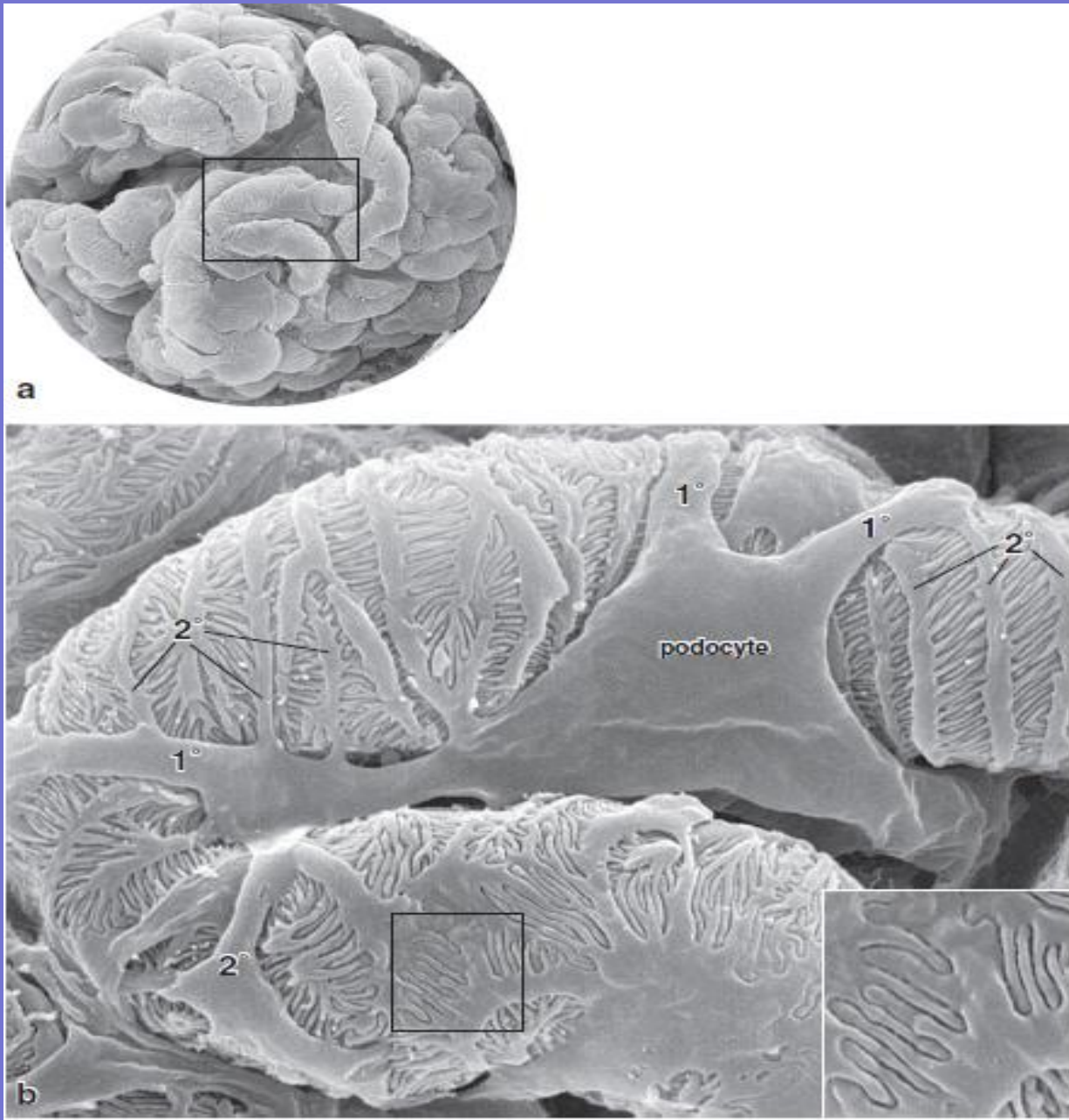
- Consist of tuft of capillaries, surrounded by Bowman's capsule (visceral and parietal layers)
- Each renal corpuscle has vascular pole and urinary pole
- Parietal layer (simple squamous epithelium) Proliferation of parietal epithelial cells is a typical diagnostic feature in certain types of glomerulonephritis (inflammation of the glomerulus)



- The visceral layer consist of podocytes ,primary processes and secondary processes which are interdigitate with each other to form the filtration slit
- Basement membrane (two basal lamina) – filtration barrier .

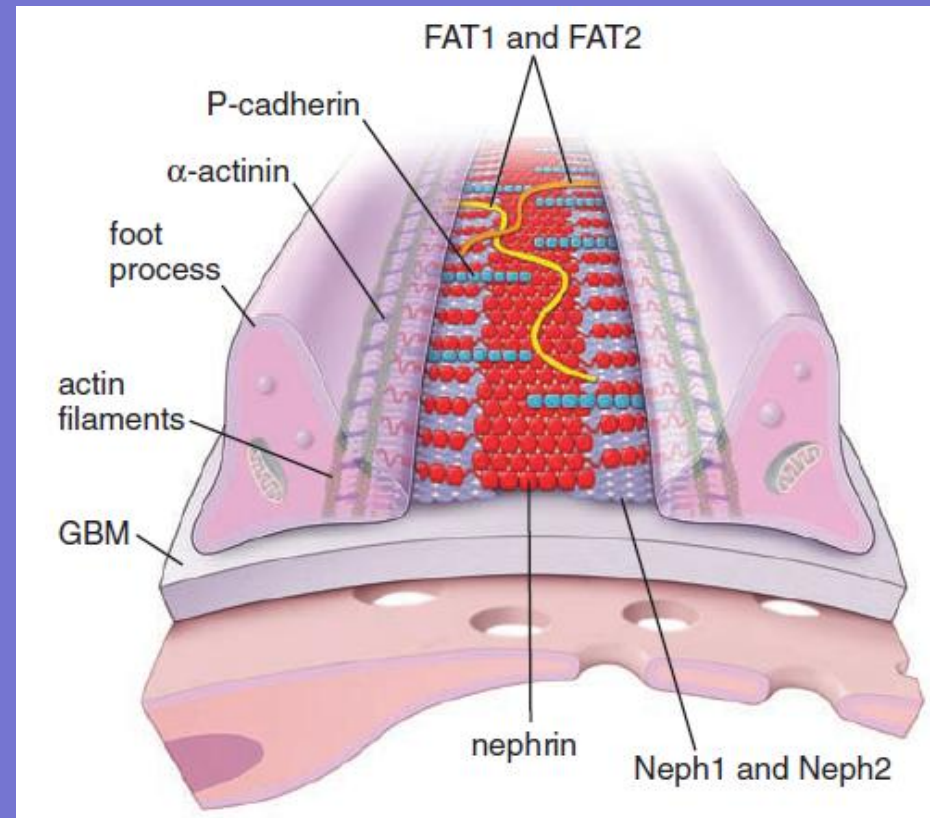


Filtration slit



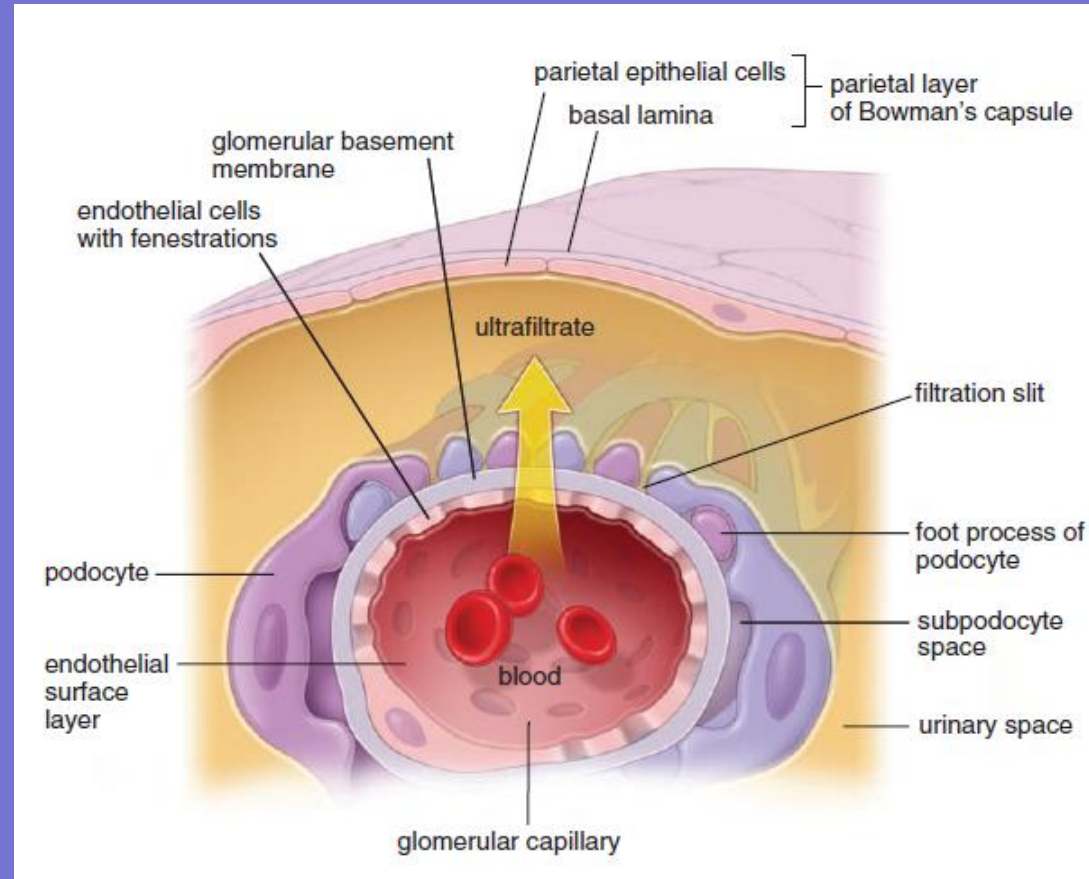
Filtration slit and diaphragm

- Nephrin is an important structural protein of the filtration slit diaphragm.
- Mutations in the nephrin gene (NPHS1) are associated with congenital nephrotic syndrome, a disease characterized by massive proteinuria and edema.



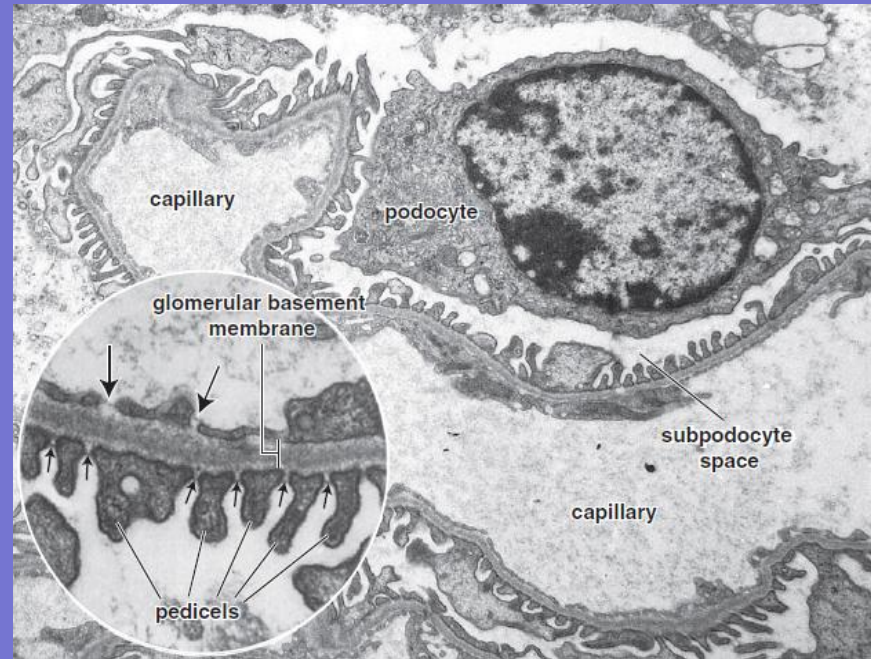
Filtration barrier

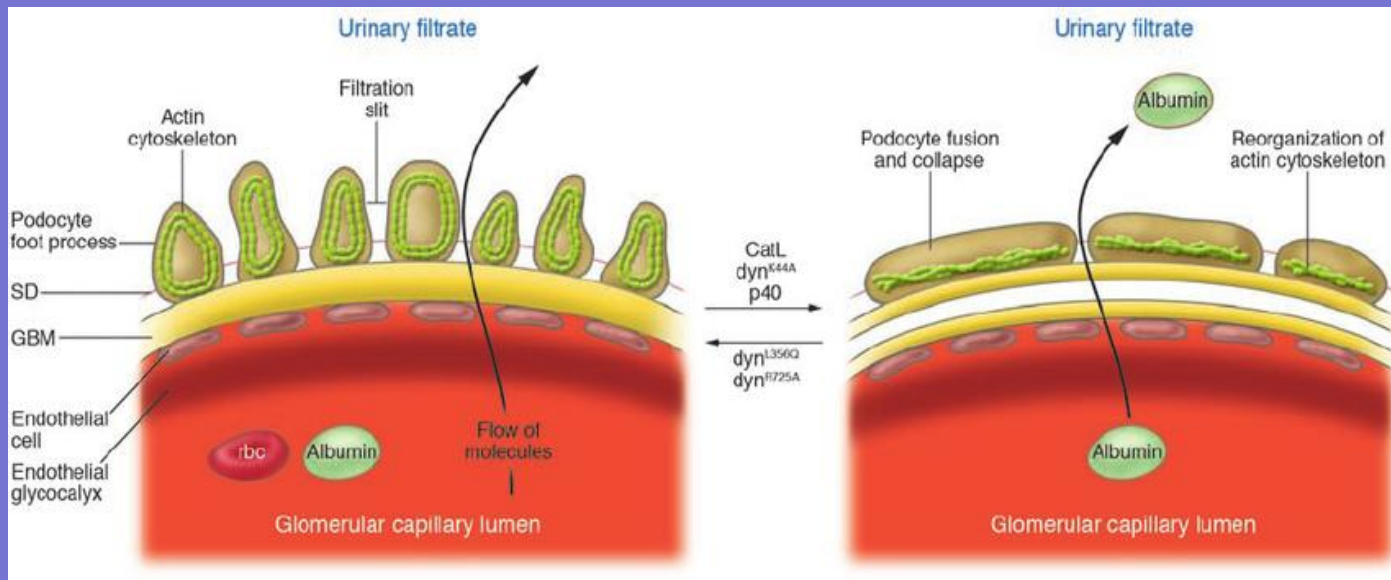
- **The renal corpuscle contains the filtration apparatus of the kidney, which consists of:**
- **The glomerular endothelium:** which possesses numerous fenestrations. These fenestrations are larger (70 to 90 nm) in diameter). Moreover, the diaphragm that spans the fenestrations in other capillaries is absent in the glomerular capillaries



Filtration barrier

- **Underlying glomerular basement membrane GBM:** The GBM is composed of a network consisting of **type IV collagen (mainly $\alpha 3$, $\alpha 4$, and $\alpha 5$ chains)**, laminin, nidogen, entactin, together with **proteoglycans** such as agrin and perlecan, as well as **multiadhesive glycoproteins**.
- *Mutation in the gene encoding for the $\alpha 5$ chain of type IV collagen gives rise to the Alport's syndrome (hereditary glomerulonephritis), manifesting by hematuria; proteinuria And progressive renal failure.*
- The visceral layer of Bowman's capsule (podocytes)



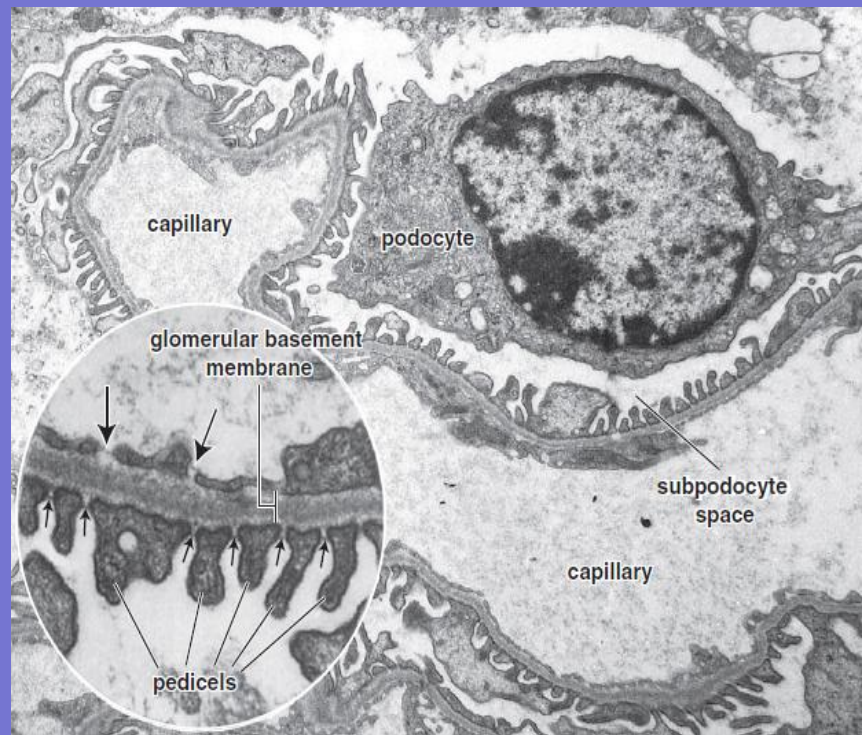


Endothelial surface layer of glomerular capillaries and subpodocyte space also make an important contribution to overall glomerular function

1. Endothelial surface layer of the glomerular capillaries

consists of a thick carbohydrate-rich meshwork (200–400 nm) attached to the luminal surface of glomerular endothelial cells. It contains **glycocalyx**,

which refers to plasma membrane-bound negatively charged proteoglycans and glycosaminoglycan side-chains peripheral membrane proteins. **Plasma proteins (e.g., albumins)** adsorbed from the blood coat the luminal surface of glycocalyx.

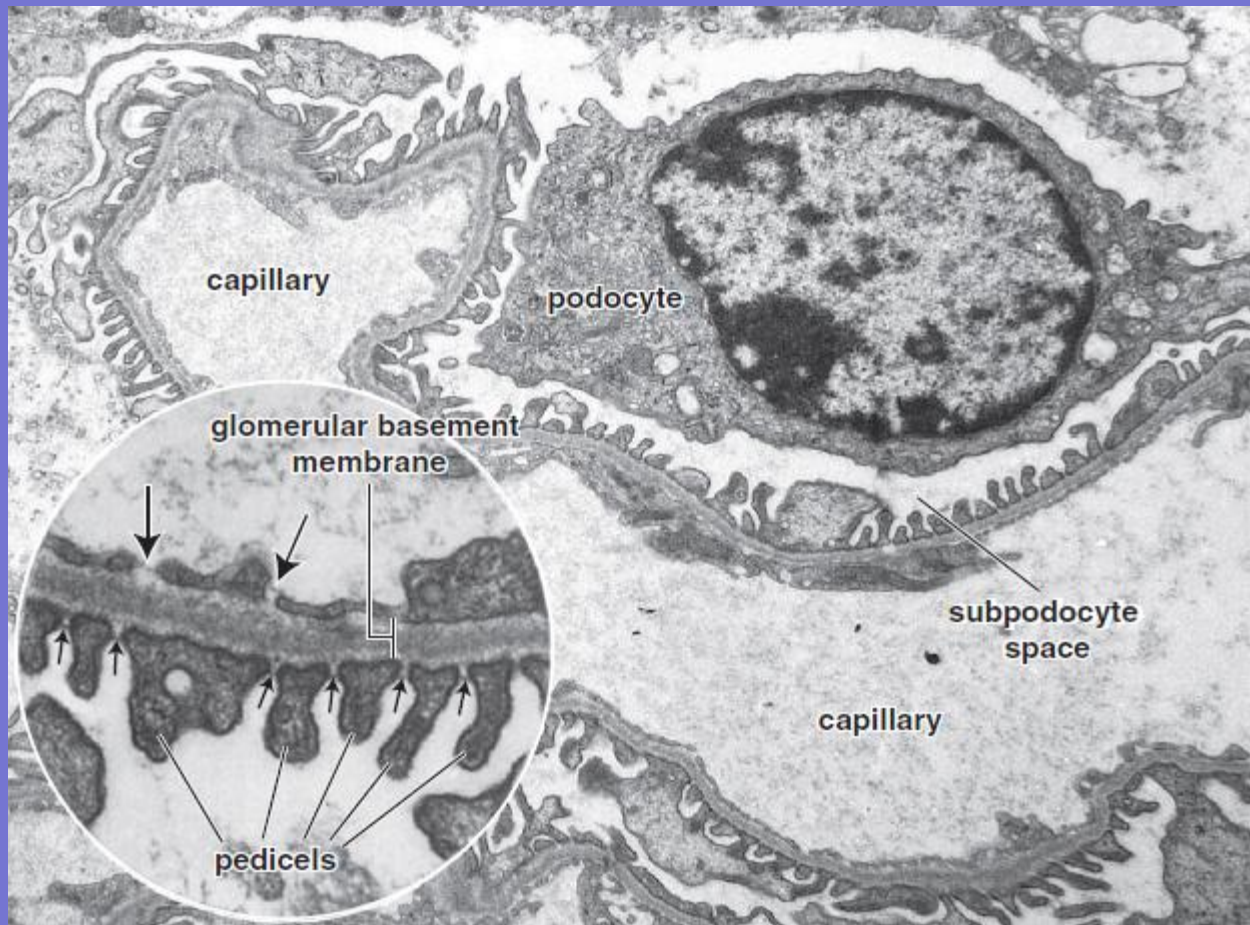


2. Subpodocyte space represents a narrow space between

The foot processes with their filtration slit diaphragms on one side and a cell body of the podocyte on the other side. Recent three-dimensional reconstruction of these spaces revealed their interconnected but structurally

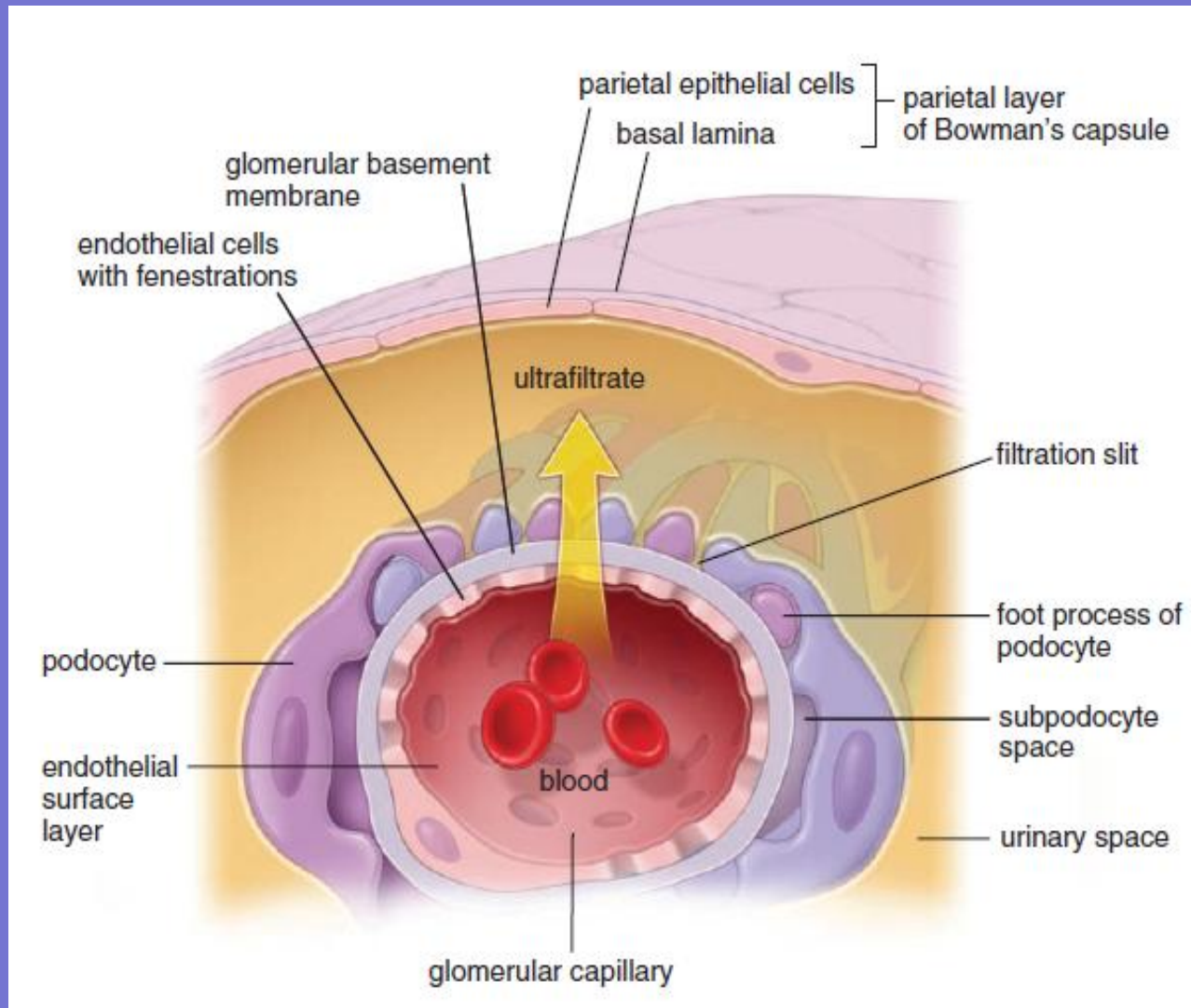
restrictive character. They cover approximately 60% of the entire surface area of the glomerular filtration barrier and may function in regulating glomerular fluid flux across the filtration apparatus.

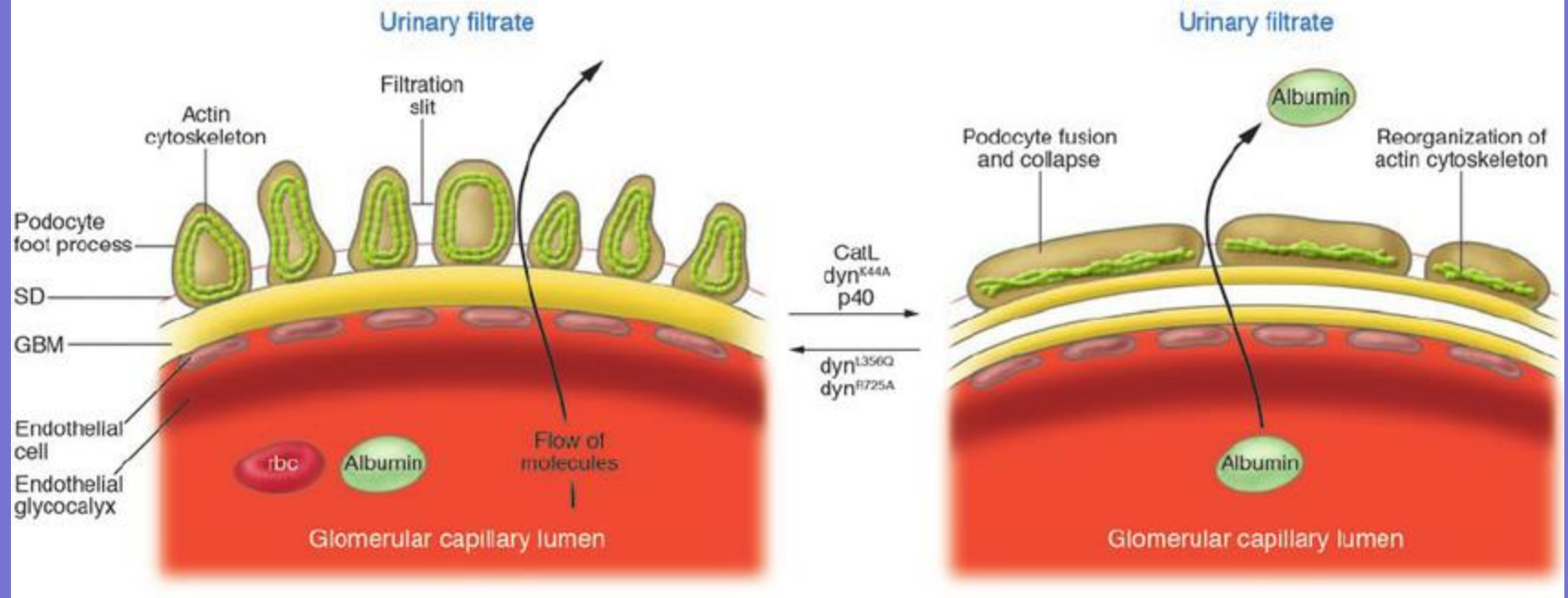
Filtration barrier



Filtration barrier

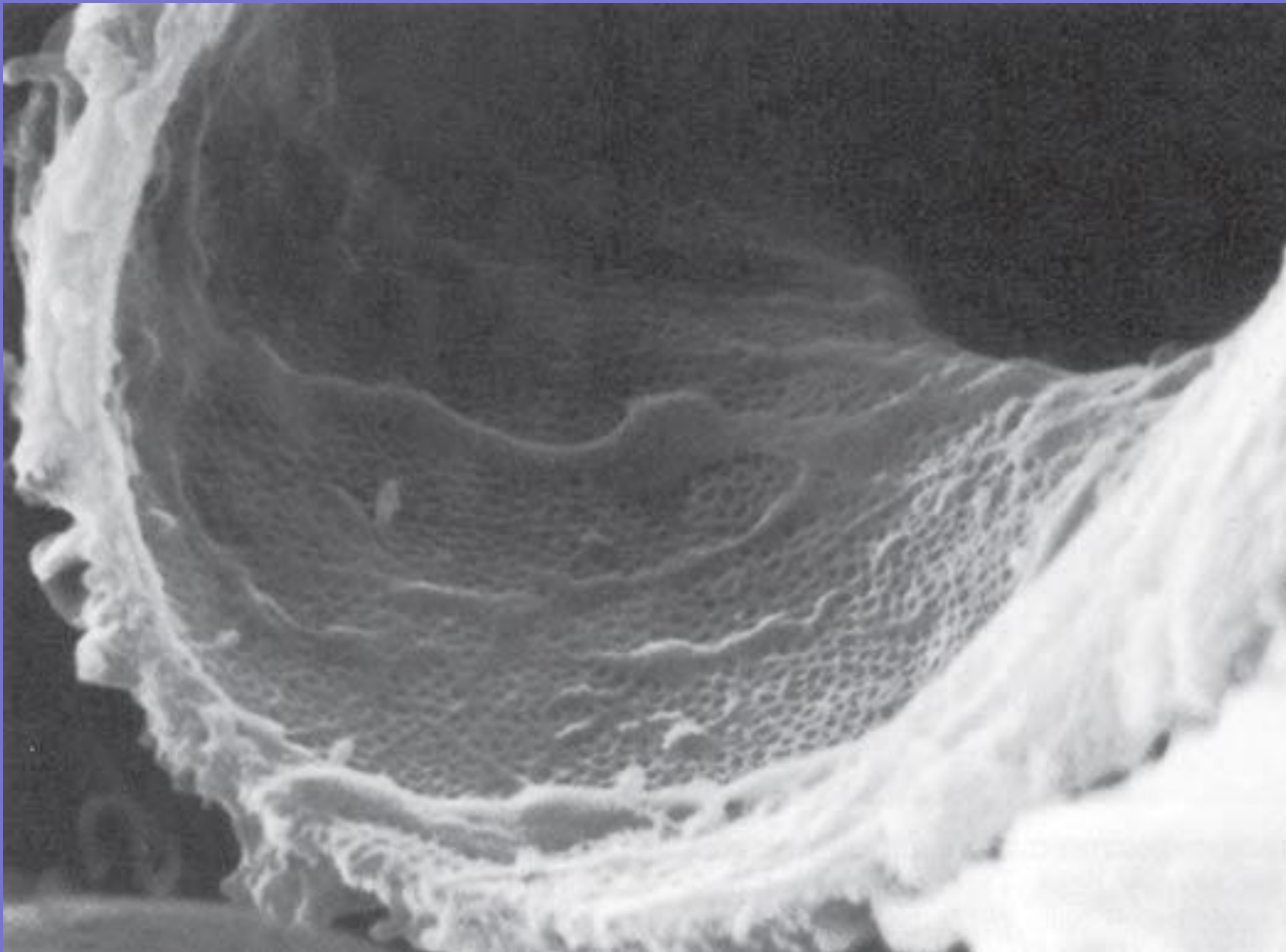
Changes in different components of the filtration apparatus influence the functions of one another.



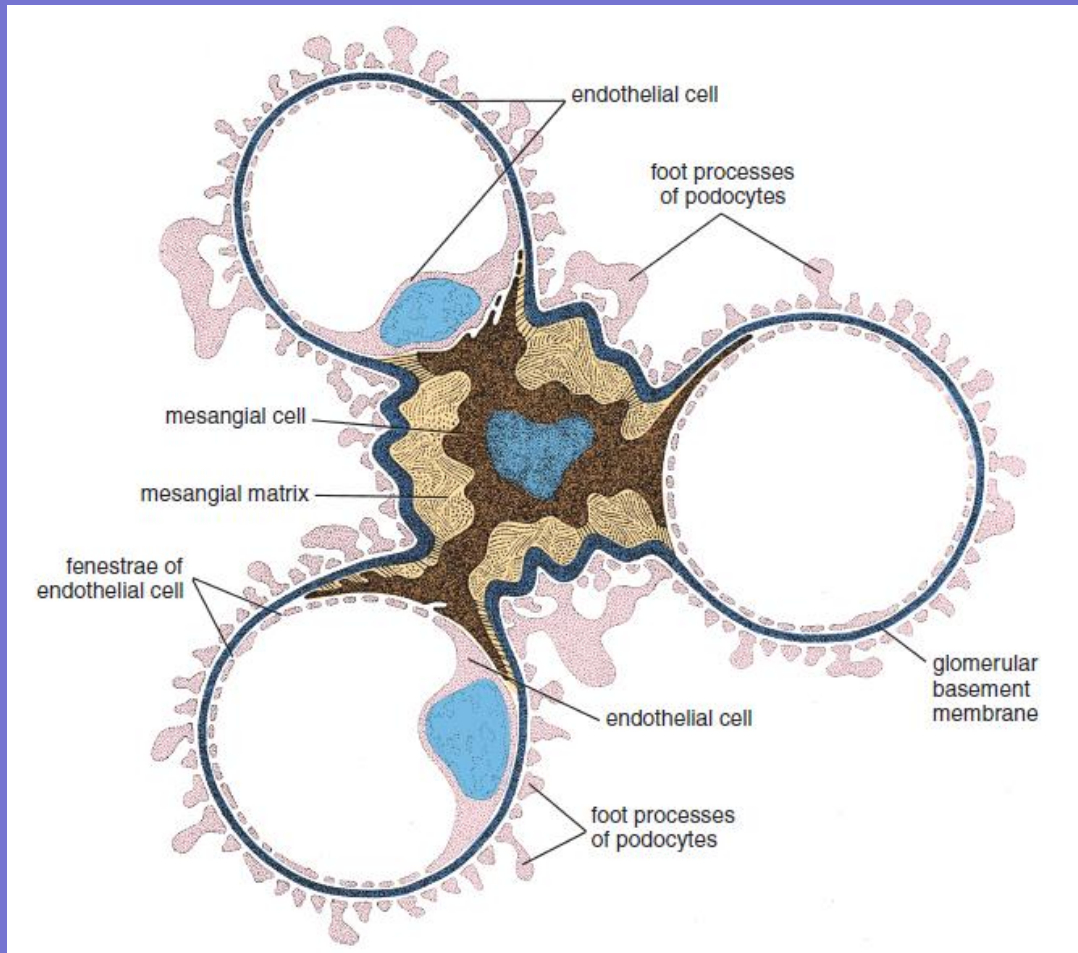


Albuminuria (presence of significant amounts of albumin in the urine) or hematuria (presence of significant amounts of red blood cells in the urine) indicate physical or functional damage to the GBM. In such cases (e.g., diabetic nephropathy), the number of anionic sites, especially in the lamina rara externa, is significantly reduced.

Fenestrated capillaries



Mesangial cells

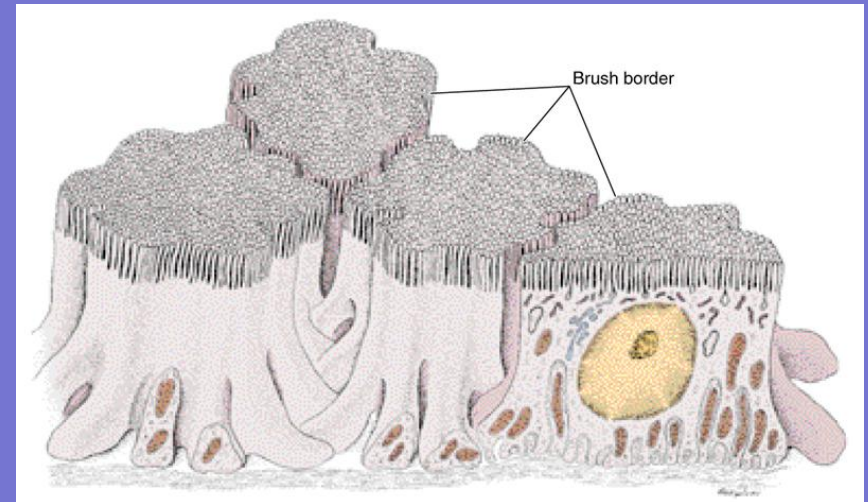


Functions of mesangial cells

- **Phagocytosis and endocytosis.** Mesangial cells remove trapped residues and aggregated proteins from the GBM and filtration slit diaphragm. They also endocytose and process a variety of plasma proteins including immune complexes. Maintaining the structure and function of glomerular barrier is the primary function of the mesangial cells.
- **Structural support.** Mesangial cells produce components of mesangial matrix, which provide support for the podocytes in the areas where the epithelial basement membrane is absent or incomplete (see Fig 20.16).
- **Secretion.** Mesangial cells synthesize and secrete a variety of molecules which play a central role in response to glomerular injury.
- **Modulation of glomerular distension.** Mesangial cells have contractile properties. The mesangial cells may function in regulating glomerular distension in response to increased blood pressure.
- **Proliferation of mesangial cells is a prominent feature in the immunoglobulin A (IgA) nephropathy (Berger disease), membranoproliferative glomerulonephritis, lupus nephritis, and diabetic nephropathy**

Proximal convoluted tubule

- Formed at the urinary pole
- Longer than DCT (in the cortex)
- The cells are acidophilic with presence of brush border
- Less number of cells
- Basal and lateral membrane interdigitation with the neighboring cells



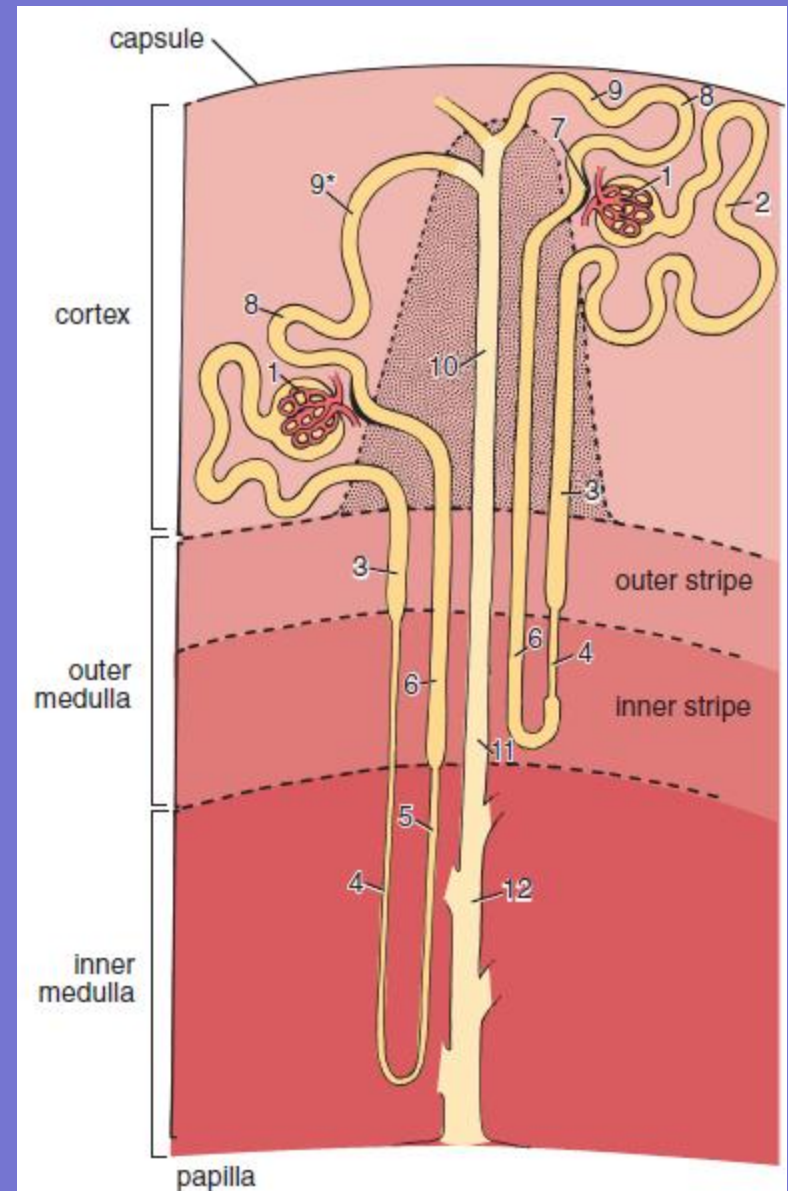
Henle's loop

Is U shaped consist from
thick and thin
descending ,thin and
thick ascending limbs

Juxtamedullary nephrons :

1. Have very long loop of henle (short thick descending ,long thin descending and ascending and thick ascending limbs)

Cortical nephron have very
short thin descending
and no thin ascending

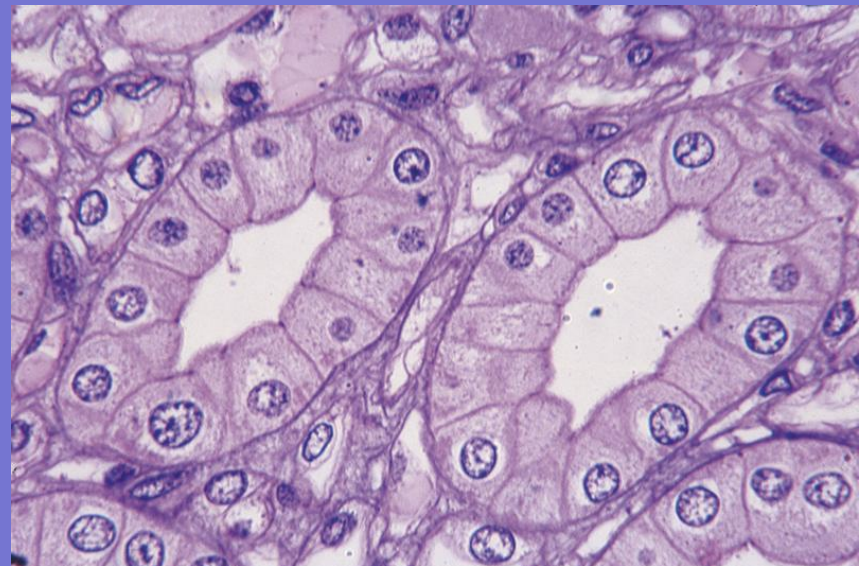
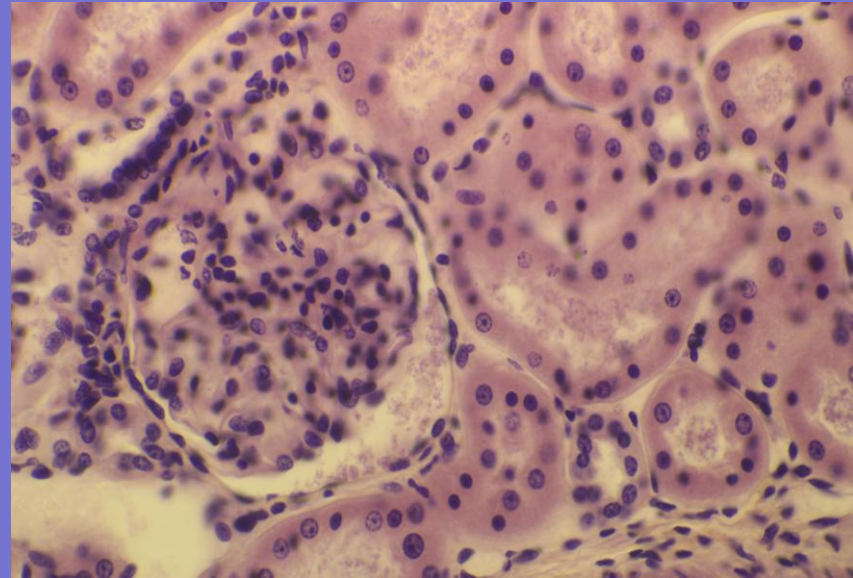


Distal convoluted tubule

- Is the continuation of thick ascending limb of loop of Henle

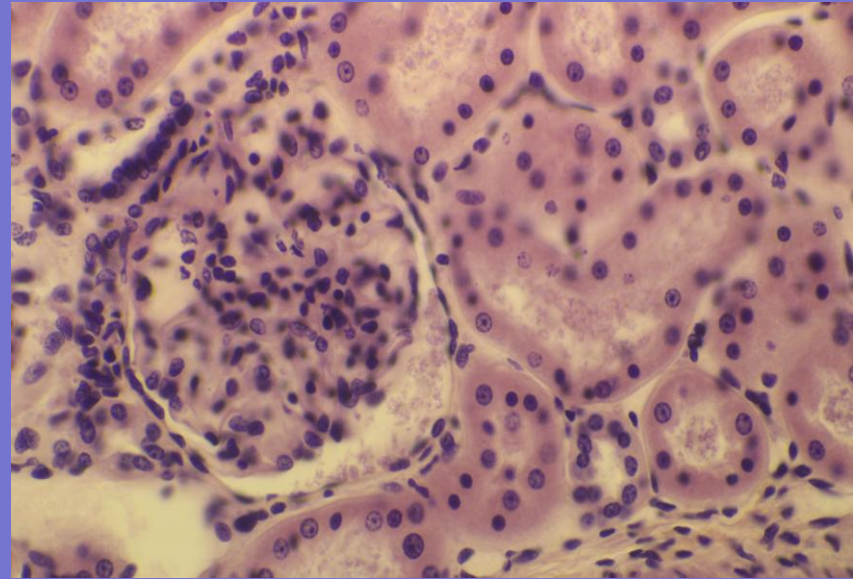
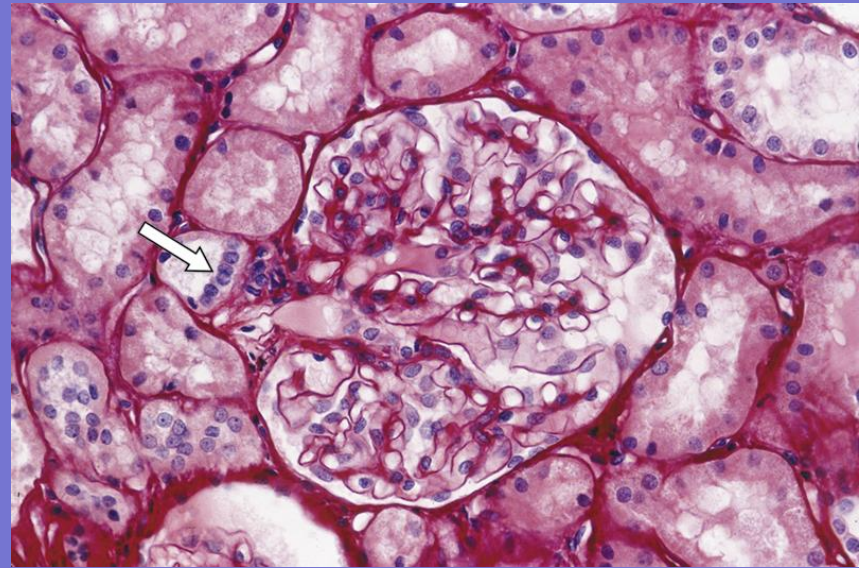
Collecting tubules

- Urine pass from the DCT to collecting tubule and then ducts
- They are lined with cuboidal epithelium
- Stain weakly
- Intercellular limits are clear



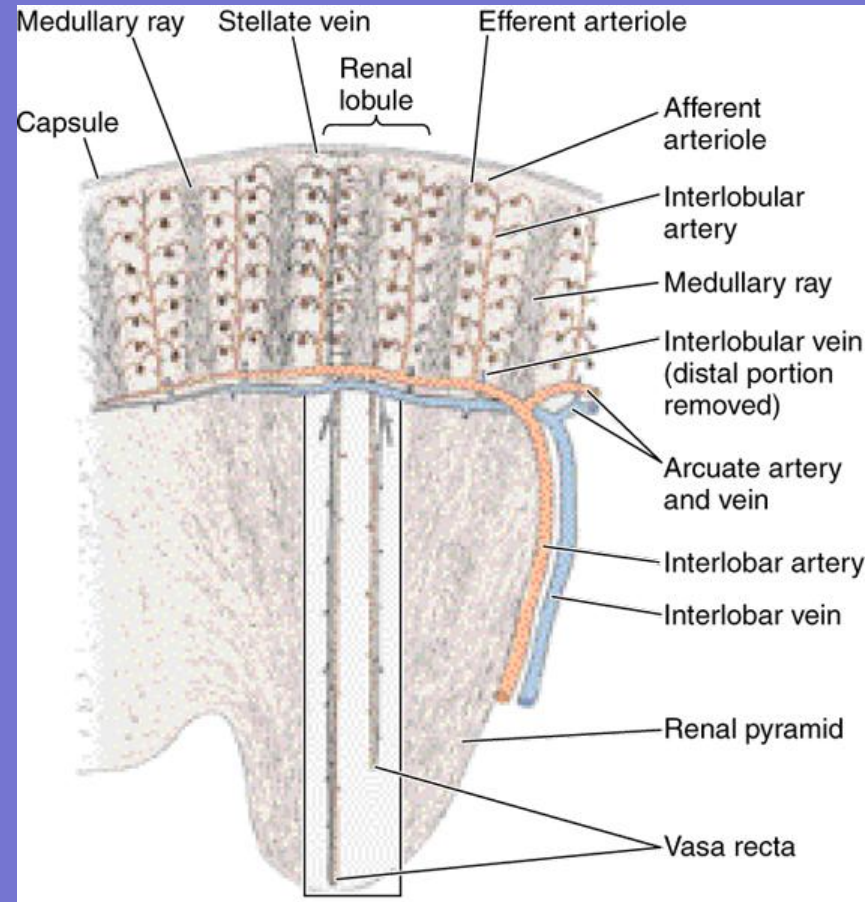
Juxtaglomerular apparatus :

- It is formed from JG cells and macula densa**
- JG cells (are modified smooth muscle cells of afferent arteriole) their cytoplasm filled with secretory granules**
- Macula densa is modified cells of DCT they become closely packed with each other**
- They secrete renin**



Blood circulation :

- Renal artery → anterior and posterior branches → interlobar branches → arcuate arteries → interlobular arteries → afferent arterioles → glomerulus
efferent → arteriole (peritubular capillaries)
- Vasa recta
- The veins follow the same course of arterial supply



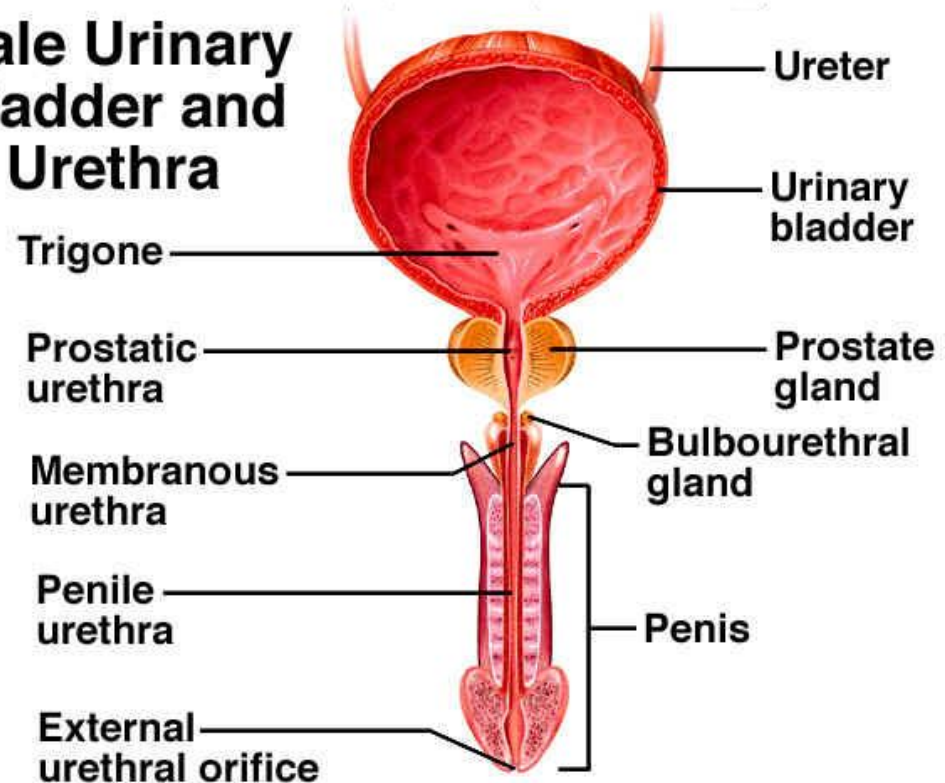
Urinary bladder

Lined with transitional epithelium

Lamina propria

Muscular layers (internal longitudinal layer, middle and outer longitudinal layer)

Male Urinary Bladder and Urethra

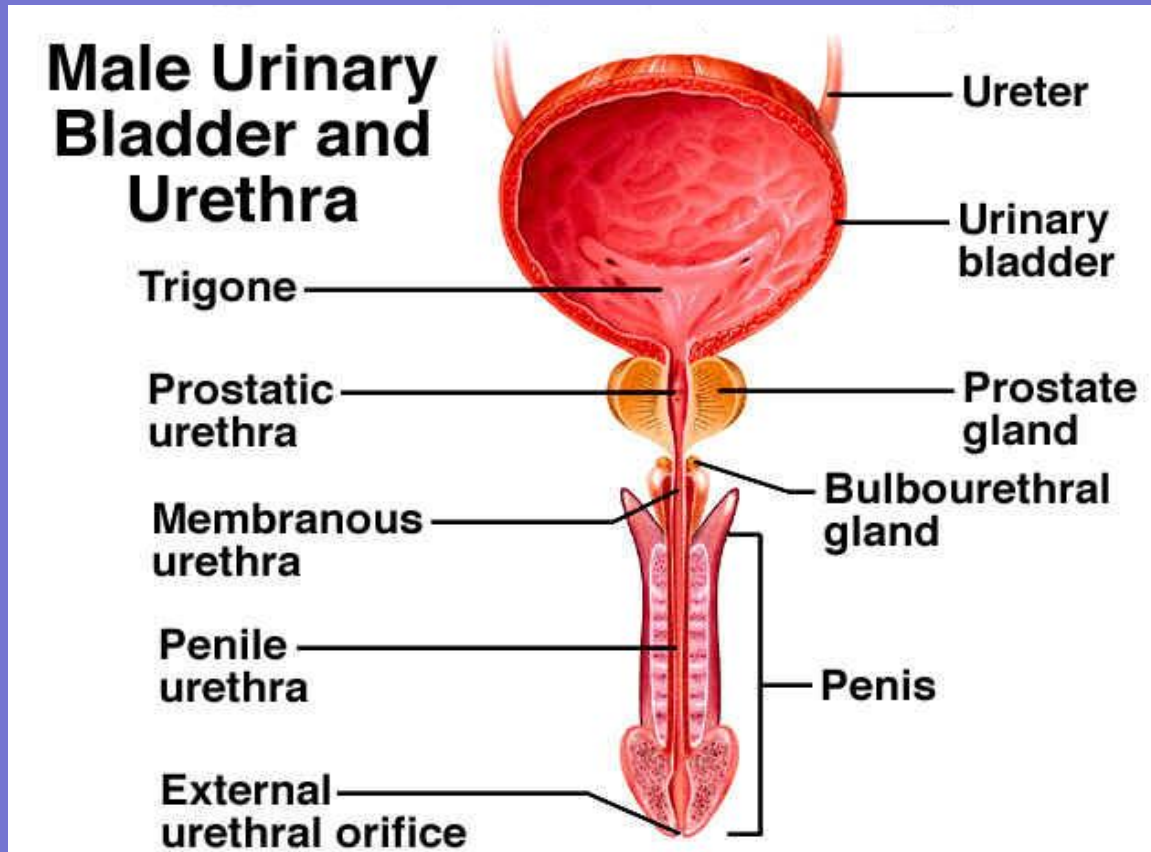


Urethra

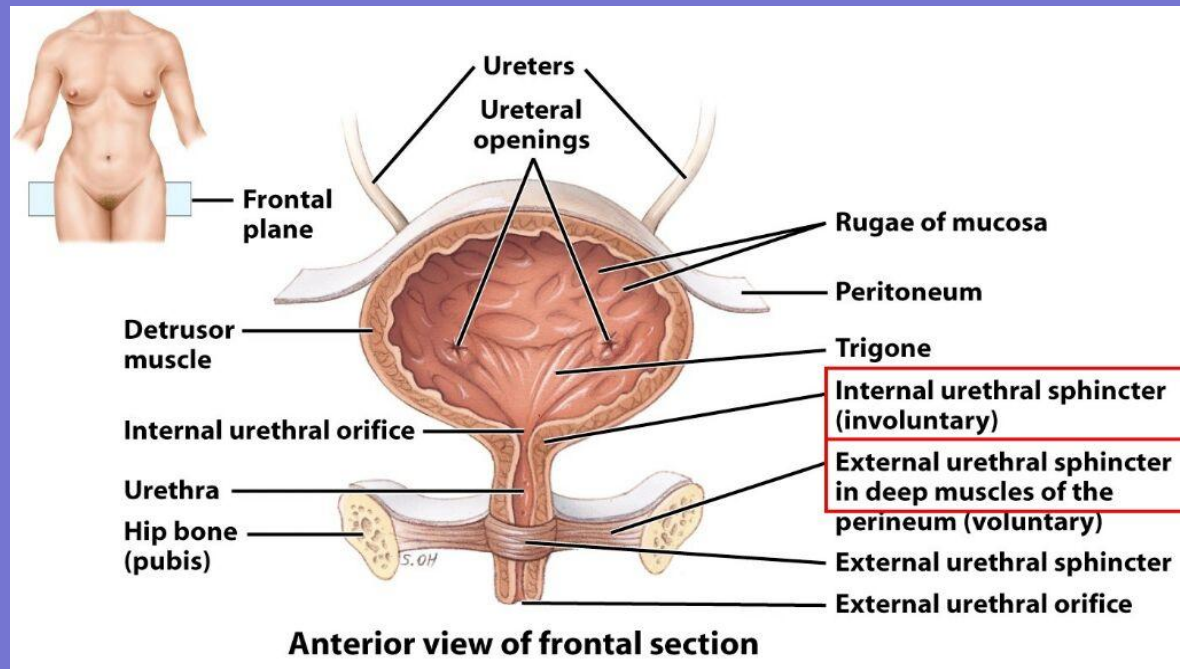
Male urethra :

Consist from prostatic, membraneous, bulbous and pendulous.

Littre's gland



Female urethra :
4-5 cm in length .



Thank you