Urinary system

Liu ying

General description

Kidneys

component :

urinary organ

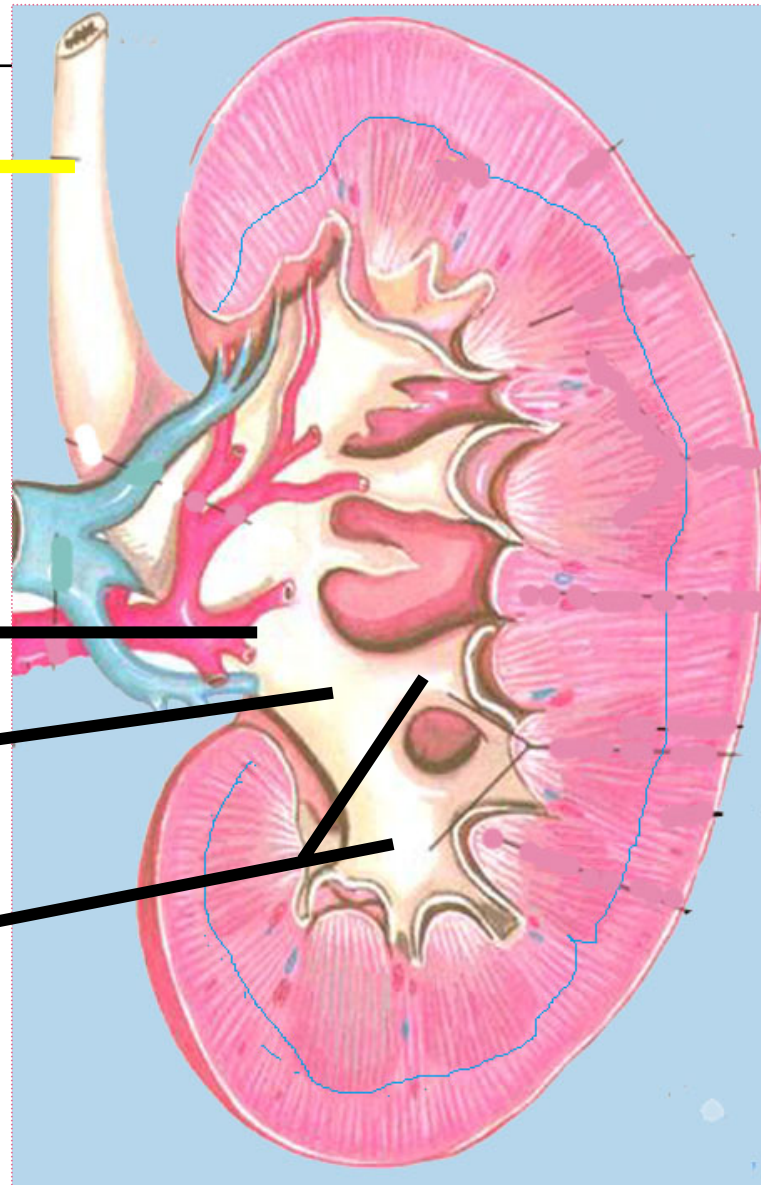
urinary passages

Ureters,
Urinary bladder,
urethra

Function: **eliminate metabolic waste**

secrete renin, erythropoietin

- concave medial border— hilum
- convex lateral surface
- renal pelvis
- major calyces
- minor calyces



capsule

parenchyma { cortex

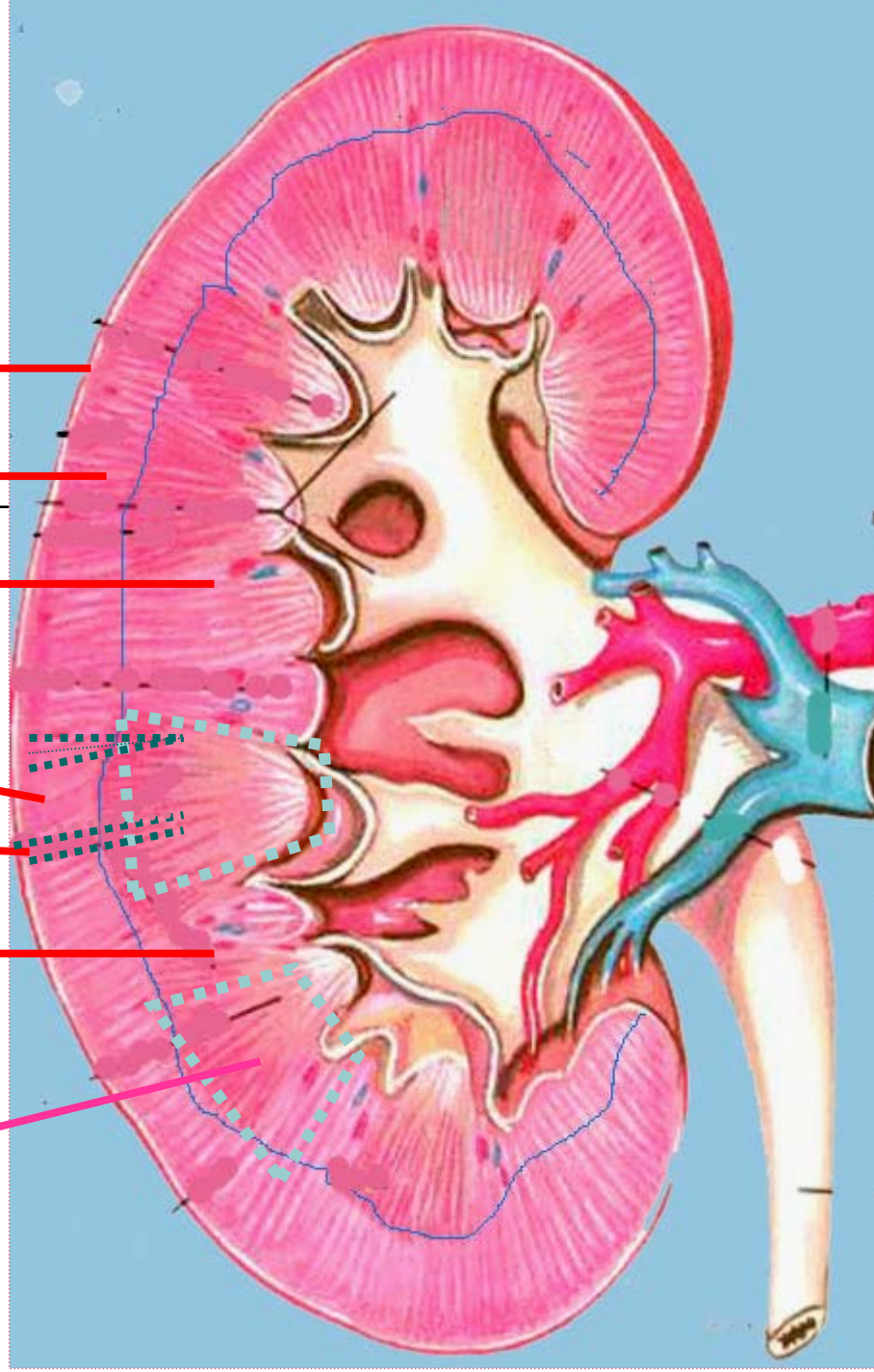
medulla

Cortical labyrinth

medullary ray

Renal column

renal pyramid



Renal lobe

A renal lobe consists of a renal pyramid, together with its closely associated cortical tissue

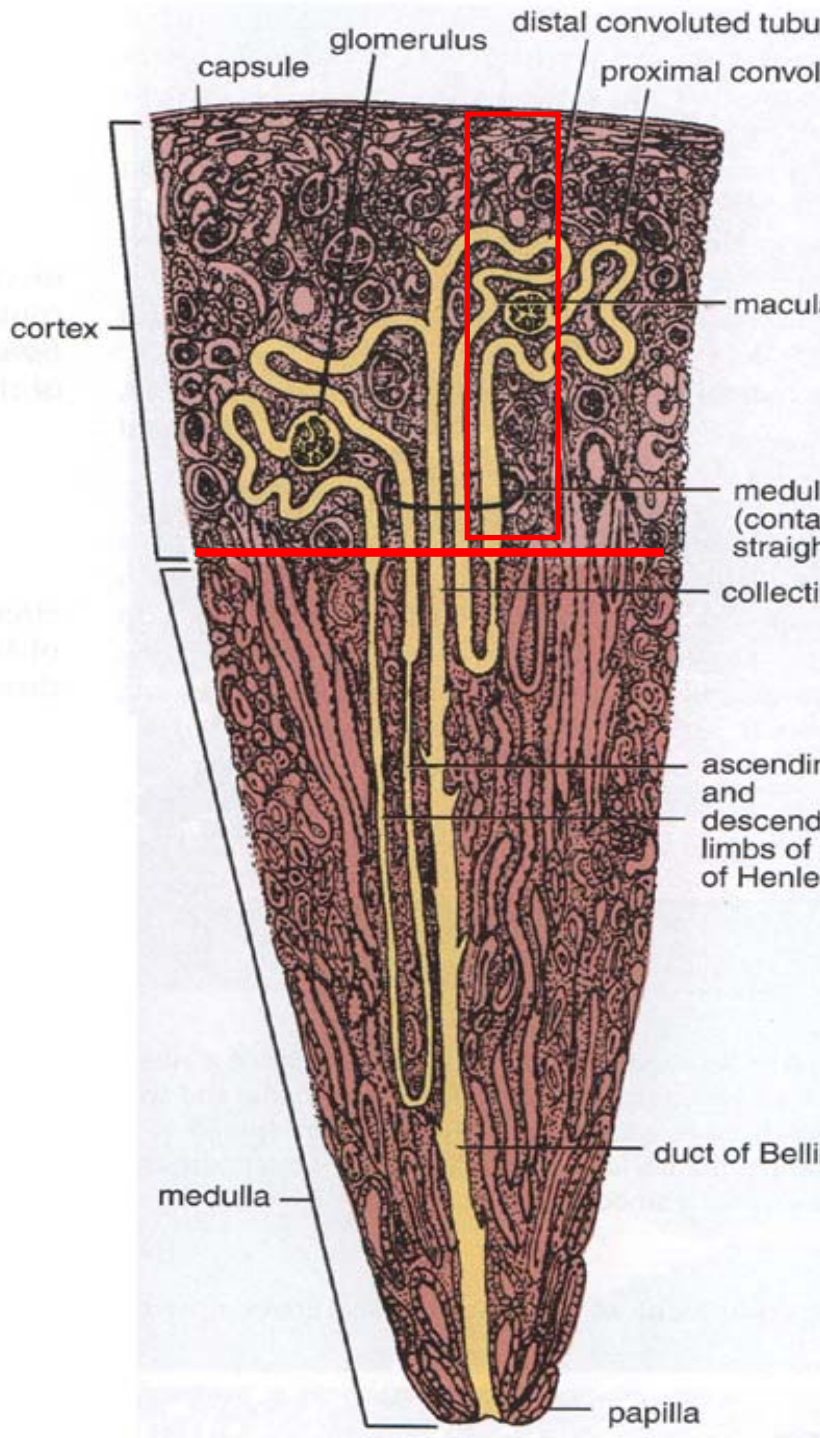
Renal lobule

A renal lobule consists of a single medullary ray and the cortical tissue that surround it

- **Renal corpuscle**
  - Glomerular capsule
  - Glomerulus
- **Nephron**
  - **Renal tubule**
    - Proximal tubule
    - Thin segment (Henle's loop)
    - Distal tubule
  - **uriniferous tubules**
  - Collecting tubules

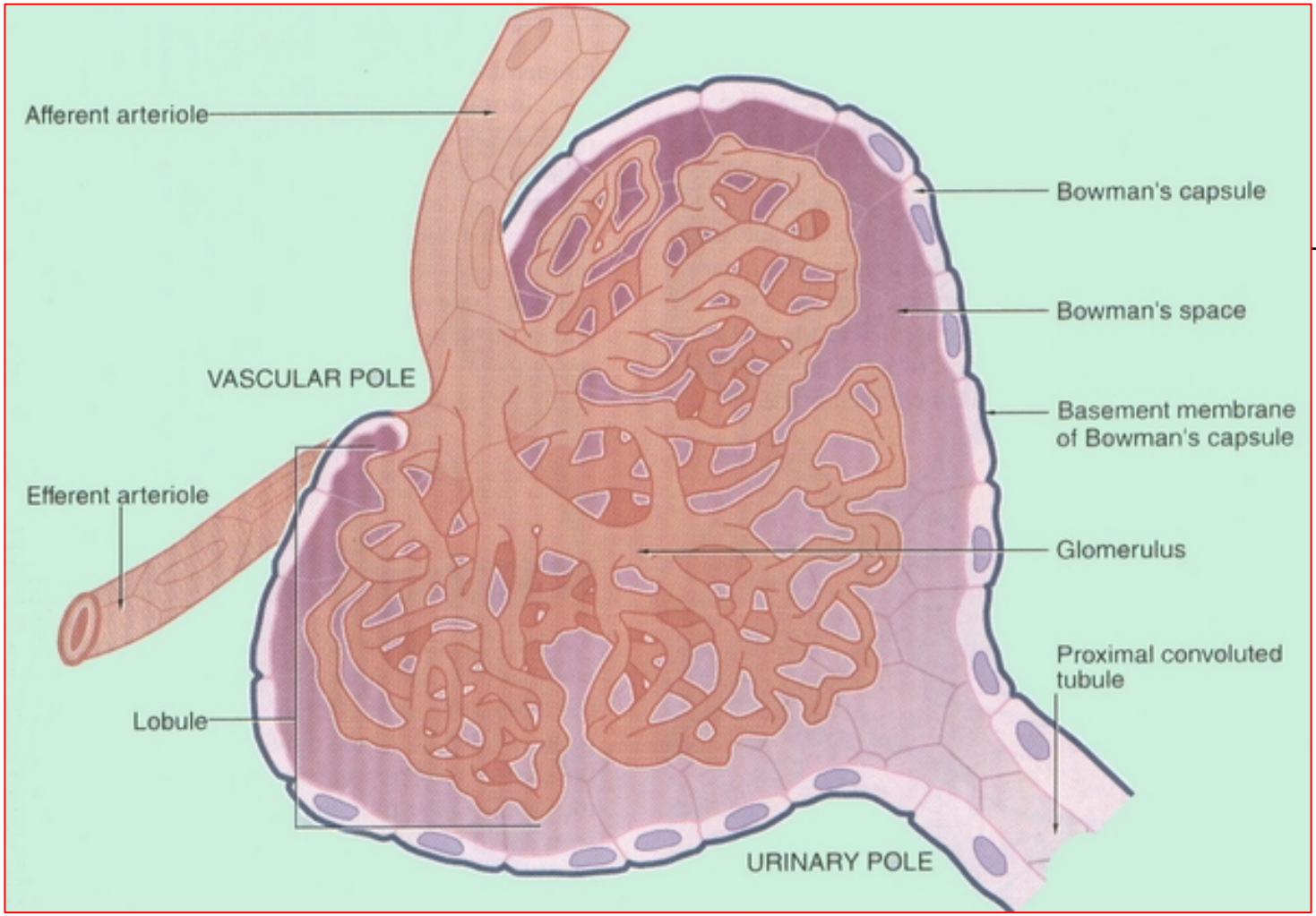
Cortical nephron

Juxtamedullary nephron



Renal corpuscle

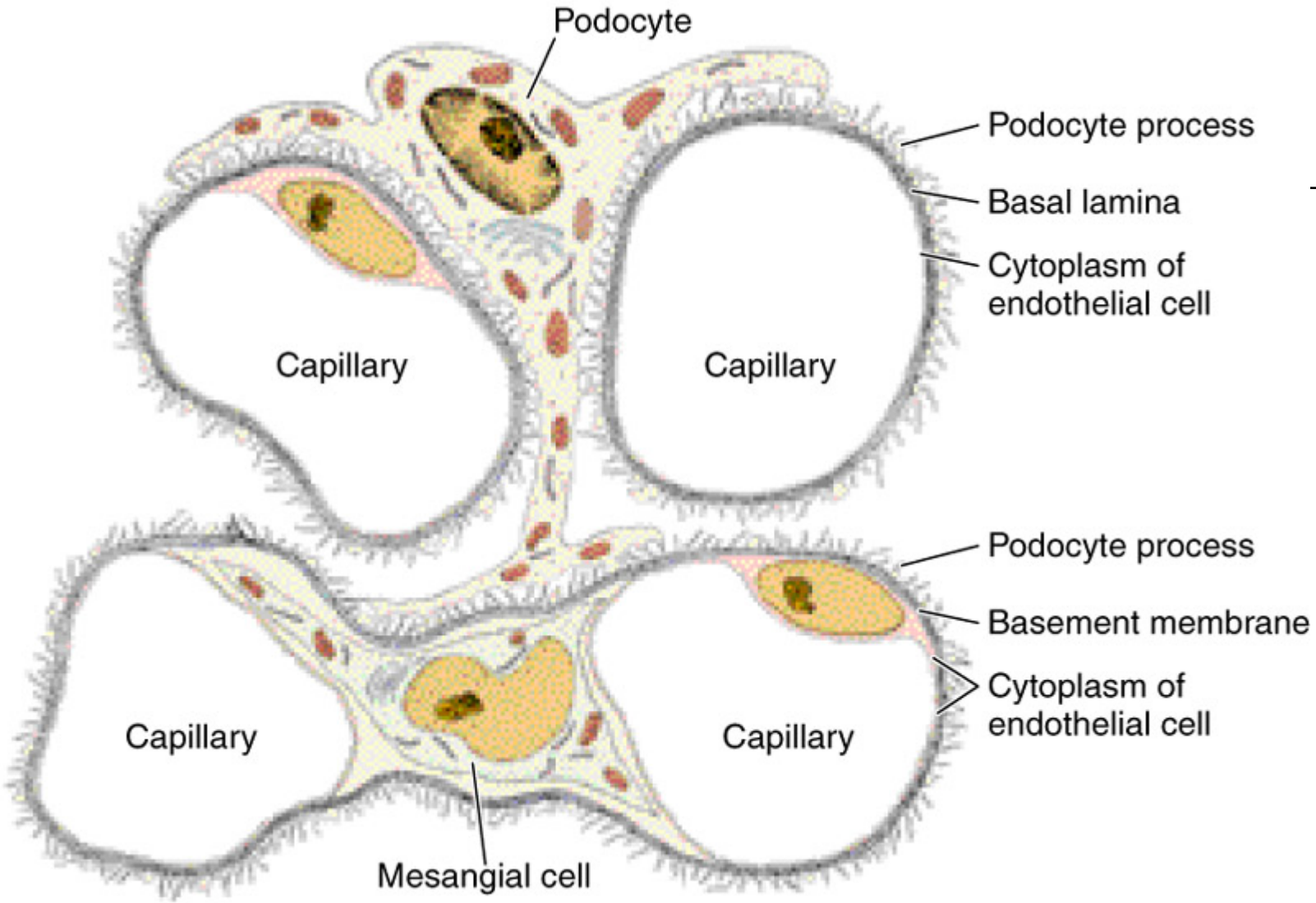
- **Morphology**
  - **vascular pole**
  - **urinary pole**
    - **renal glomerulus**
    - **Glomerular capsule**
- **Function**
  - **Filtration**
  - **form primary urine**



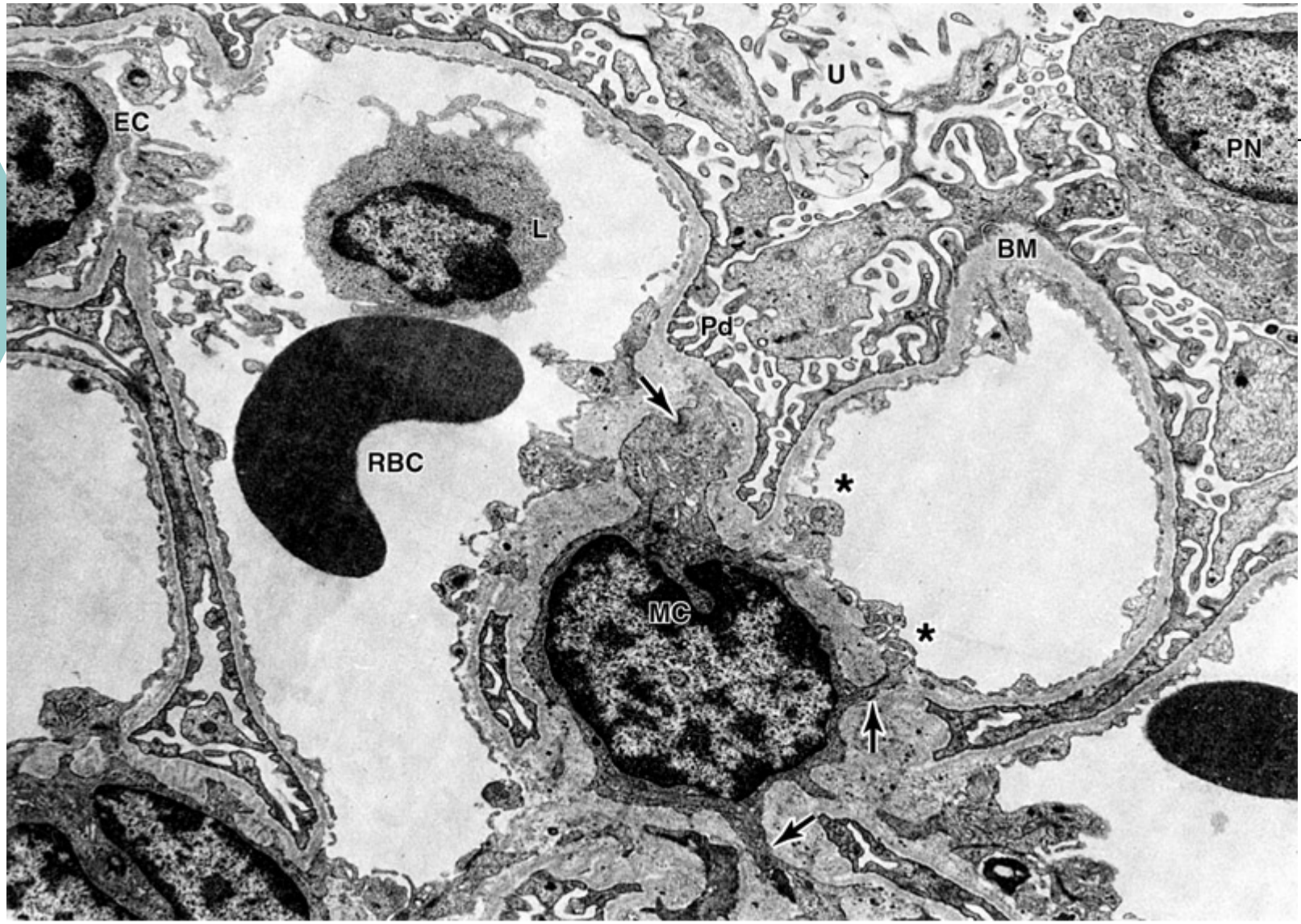
a. renal glomerulus: anastomizing fenestrated Caps without diaphragm. It has **high hydrostatic pressure.** This primary Cap network of portal circulation are linked by Mesangial cells.

The reason of high hydrostatic pressure in glomeruli

- composed of arterial capillaries in which the hydrostatic pressure is higher than that found in other capillaries.
- The afferent arterioles are thicker than the efferent ones.



Mesangial cell located between capillaries enveloped by the basement membrane.



Electron micrograph showing a mesangial cell (MC)

MCs

receptors

- **for angiotensin Ⅱ → blood flow is reduced**
- **for natriuretic factor → blood flow is increased**

Cardiac atria cells

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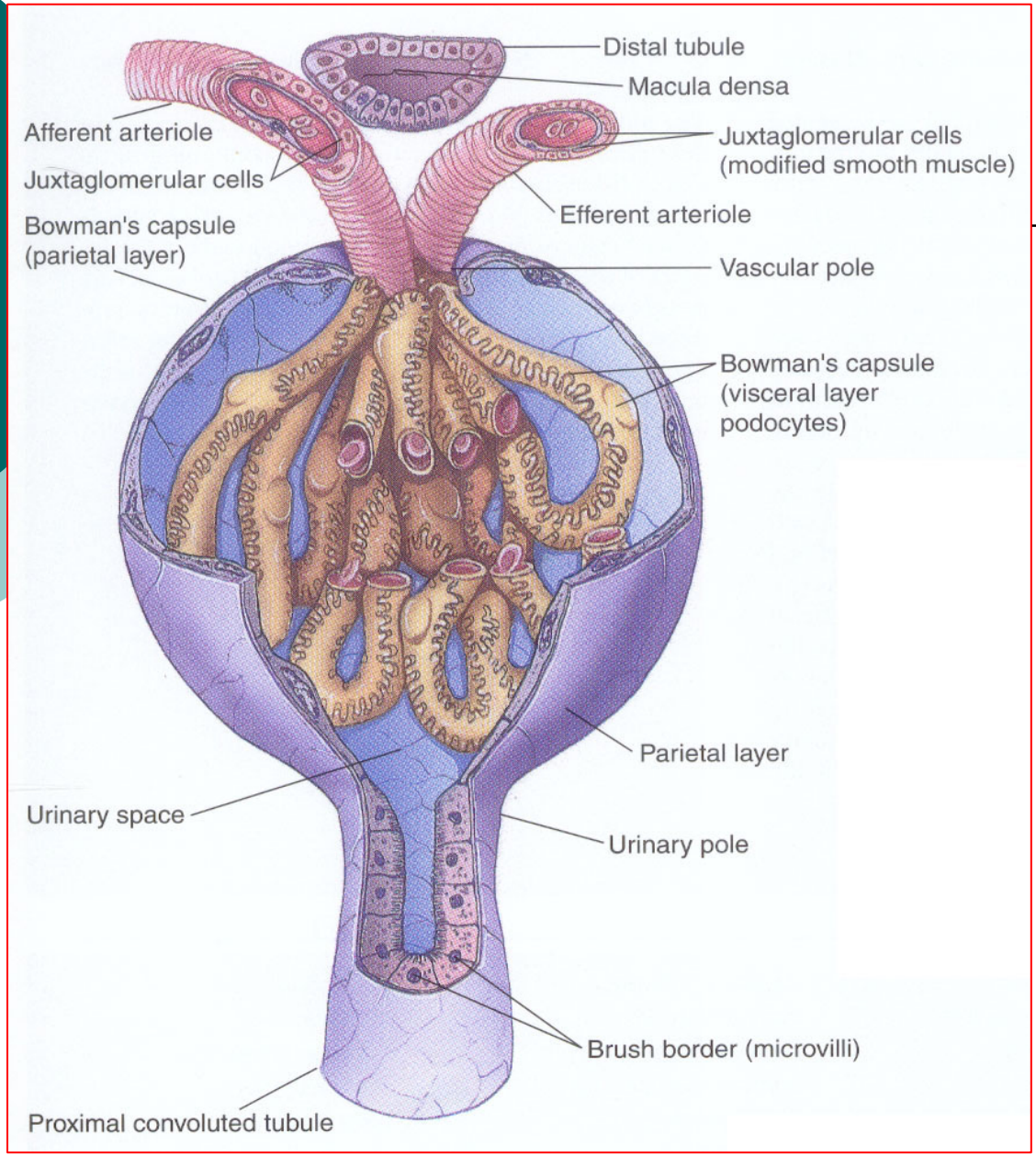
synthesize extracellular matrix, give structural support

produce chemical mediator (cytokines, prostaglandins)

dispose of immune complex



b. glomerulus capsule (Bowman's capsule):

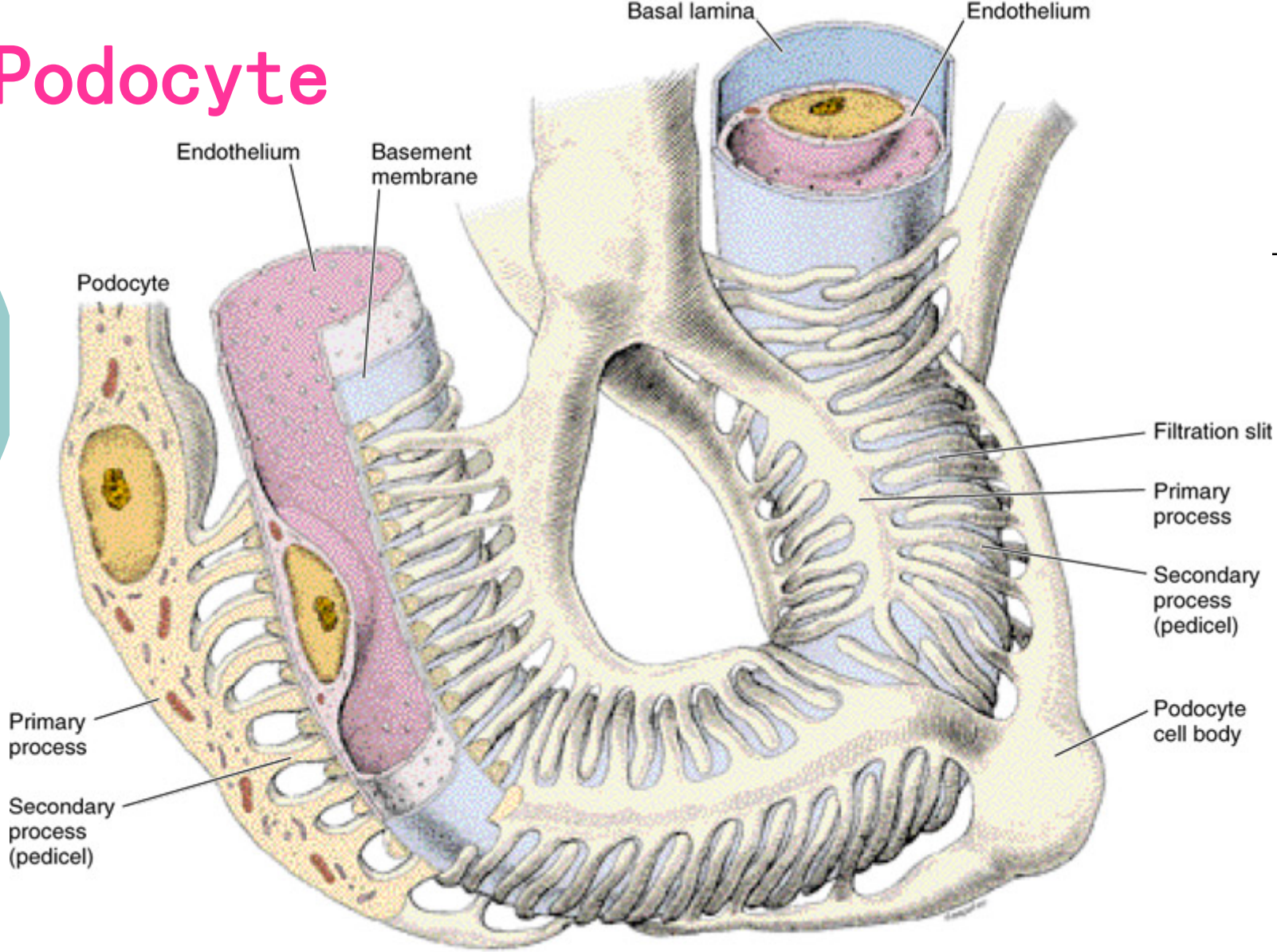
* parietal layer: lined by simple squamous epithelium.

•visceral layer: composed of podocytes

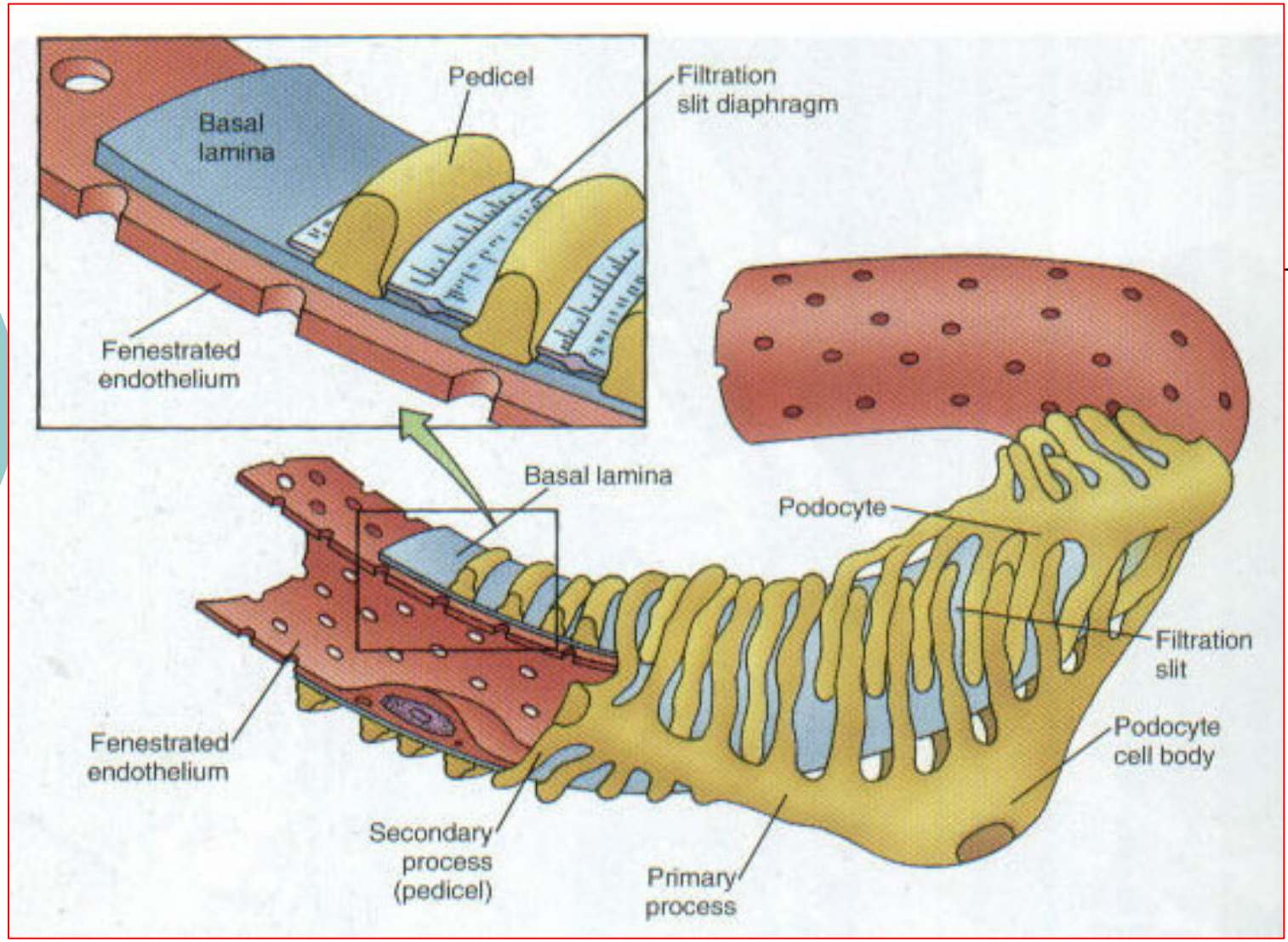
•Bowman's spaces: (urinary space)

pre-urine that comes from the filtration of the blood, contains a great amount of nutrients, and is about 150~200 liters per day.

Podocyte



The Cap are embraced by interdigitating pedicels. The 25nm-wide spaces between the pedicels, the filtration slits, are covered by 6nm thick slit membranes that span the adjacent pedicels.



- filtration membrane (blood-urine filtration barrier): composed of endothelia, slit membrane and fusedbasal laminae, which is derives from the fusion of the basal lamina of capillaries and podocytes.

filtration membrane

EM of the filtration barrier in a renal corpuscle. Note the endothelium (E) with open fenestrae (arrowhead), the fused basal laminae of epithelial and endothelial cells (BL), and the processes of podocytes (P).

Functions of filtration barrier

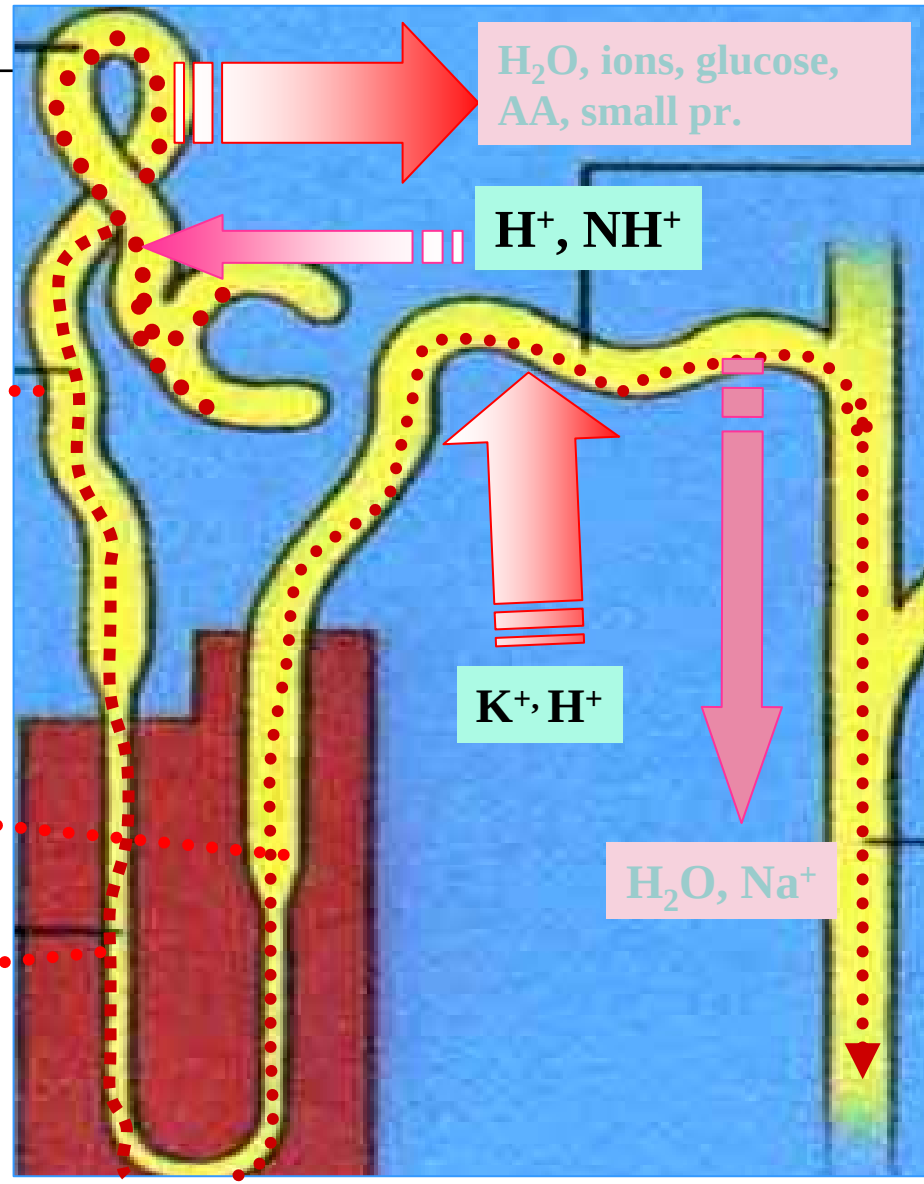
- To filter the blood plasma
- To permit water,ions and small molecules to pass (into the capsular space).
- To prohibit proteins and greater molecules (greater than 69,000) into Bowman's space.

Renal tubule

Proximal tubule
(convoluted and straight)

Distal tubule
(straight and convoluted)

Thin segment

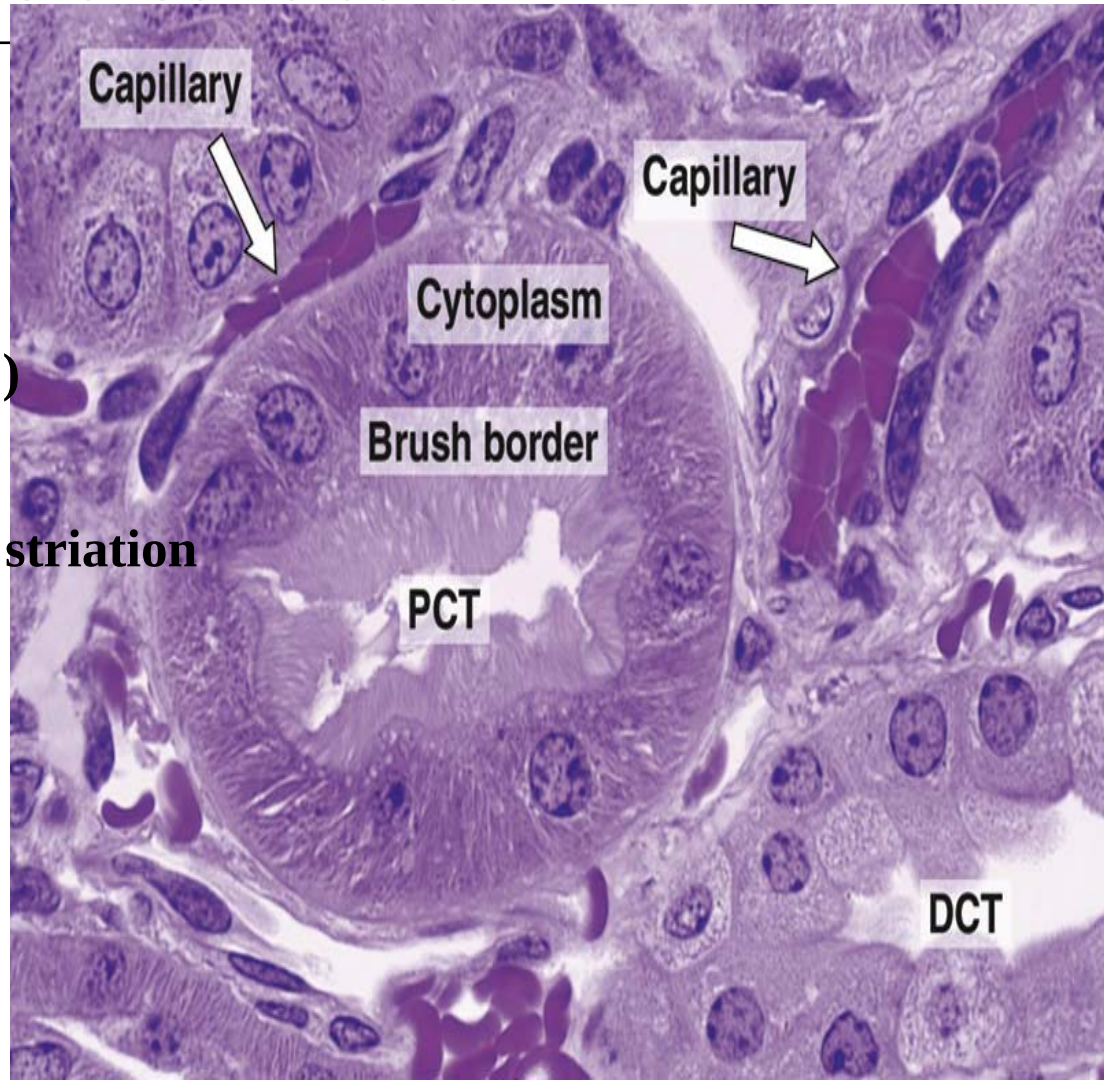


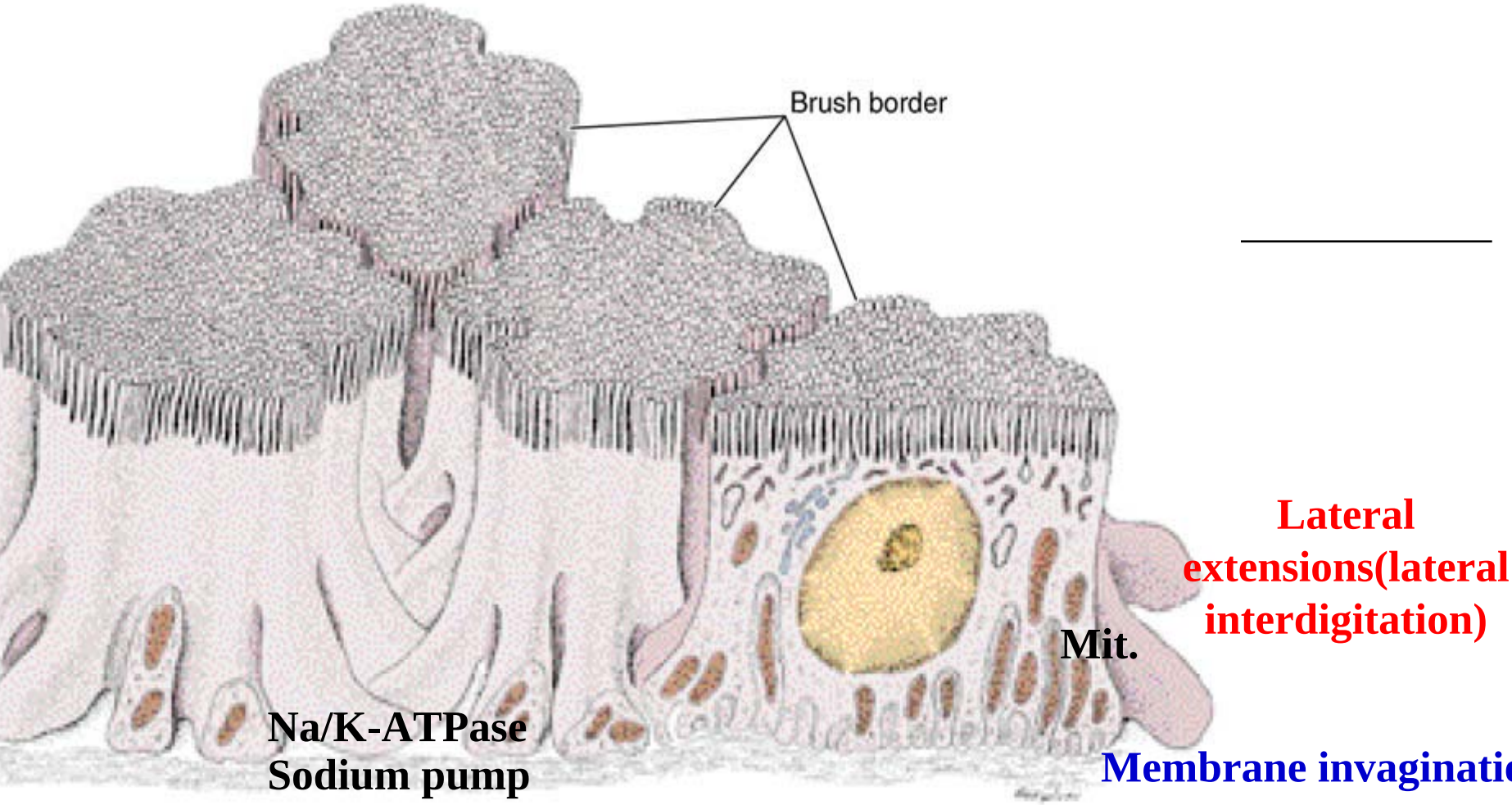
Proximal convoluted tubule

Thick wall, small lumen

LM
- **Free surface: brush border**
- **Cytoplasm: acidophilic (HE)**
- **Cells: no discrete margins**
- **Basal surface: longitudinal striation**

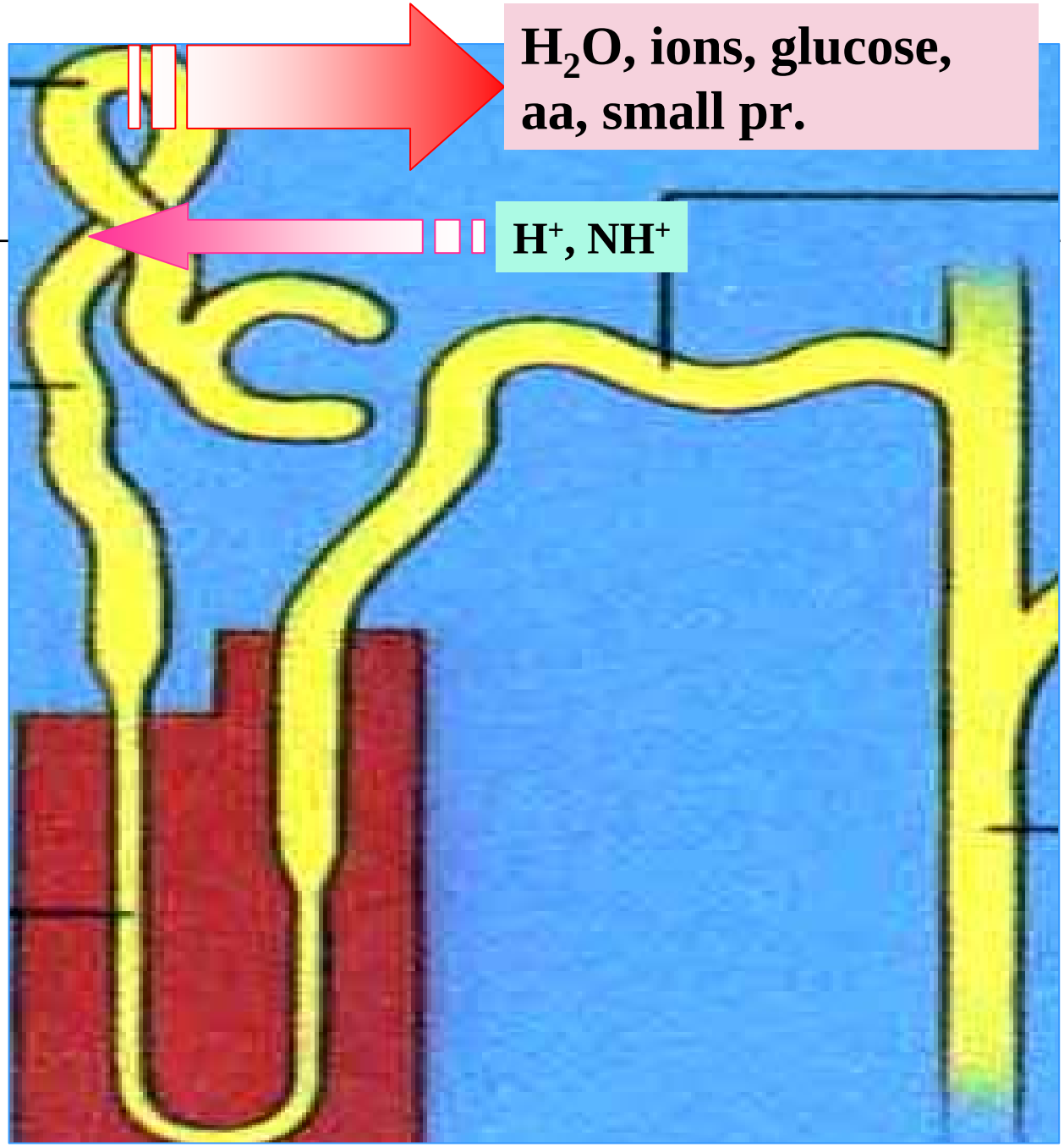
EM
- **microvilli**
- **Endocytic vesicles**
- **Lateral extensions**
- **Membrane invaginations**
  mit.



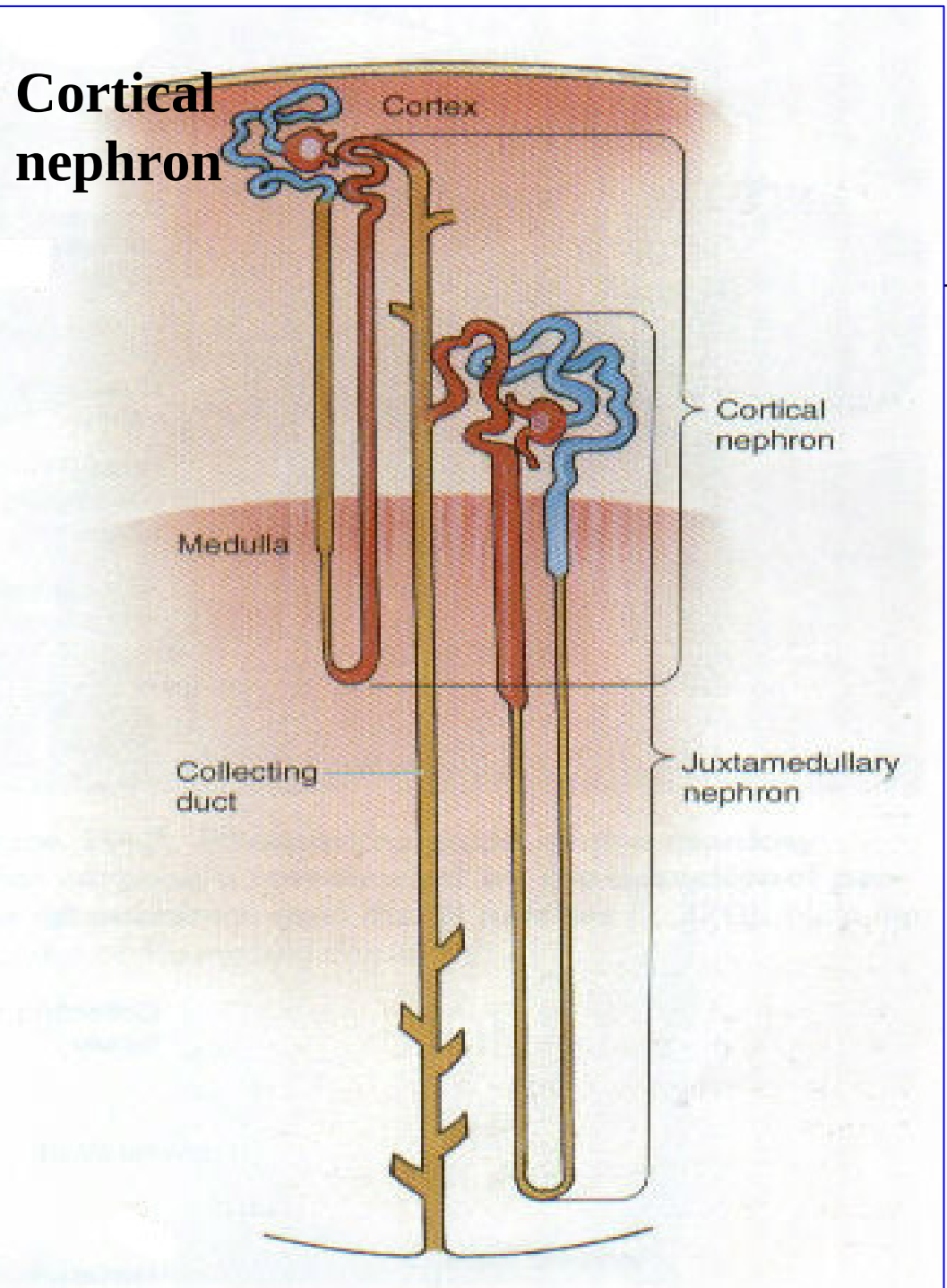


Schematic drawing of PCT cells. The apical surfaces of these cuboidal cells have abundant microvilli constituting a brush border. Note the distribution of mit. and associated basilar infoldings of the cell membrane. The lateral extensions are longer and penetrate deeply among the neighboring cells.

Function: reabsorption



Cortical nephron



b. Henle's loop: consists of 4 segments.

- **thick descending limb (proximal straight tubule): similar in structure to the proximal convoluted tubule.**
- **thin descending limb: lined by simple squamous epithelium.**
- **thin ascending limb: lined by simple squamous epithelium.**
- **thick ascending limb (distal straight tubule): similar in structure to the distal convoluted tubule.**

Henle's Loop (nephron loop,medullary loop)

LM

Thin wall

wide lumen

Simple squamous epi.

EM

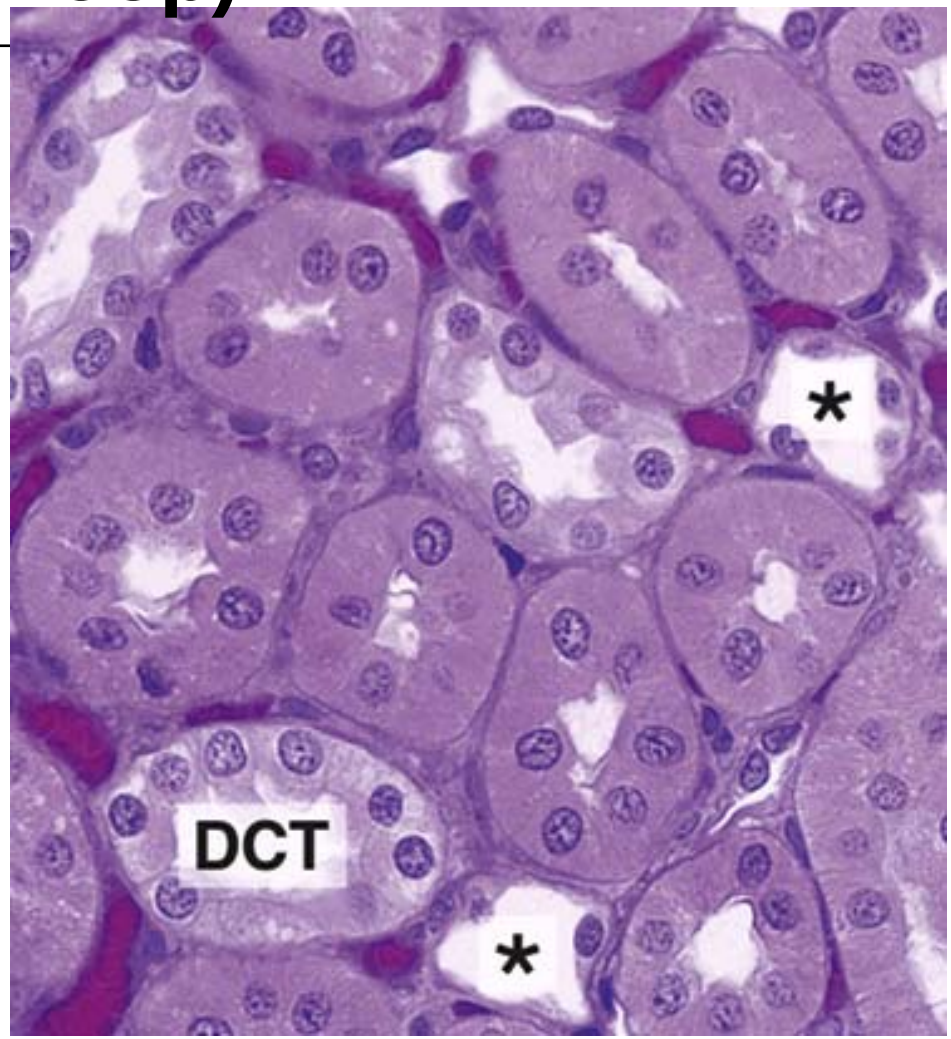
Few microvilli

Few membrane invaginations

Undeveloped organelles

function

permeable to water and salt

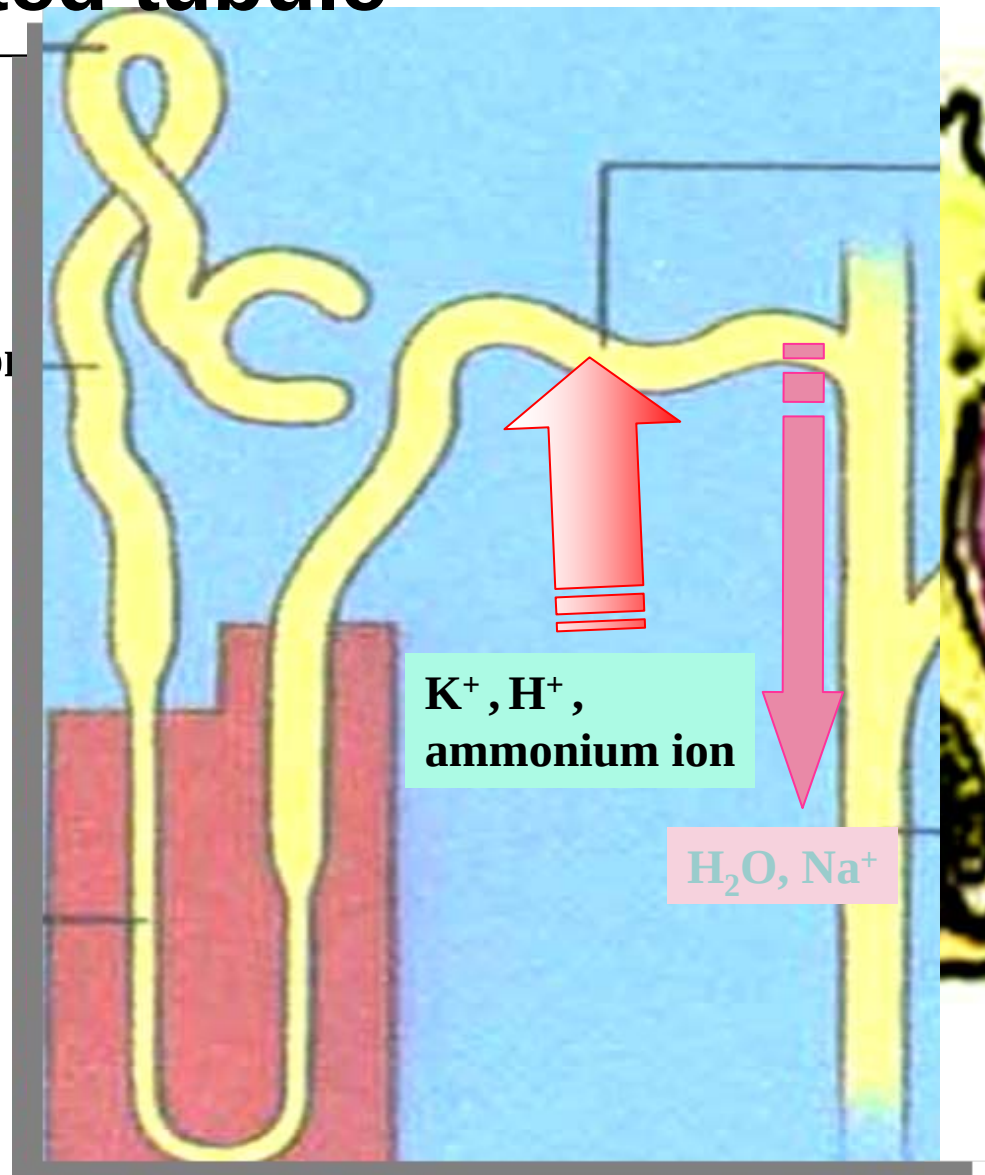


Distal convoluted tubule

LM
- Cell in light staining
- No brush border
- Prominent longitudinal striation

EM
- Less microvilli
- Membrane invaginations

Function: actively reabsorb Na^+ and H_2O



Collecting tubules

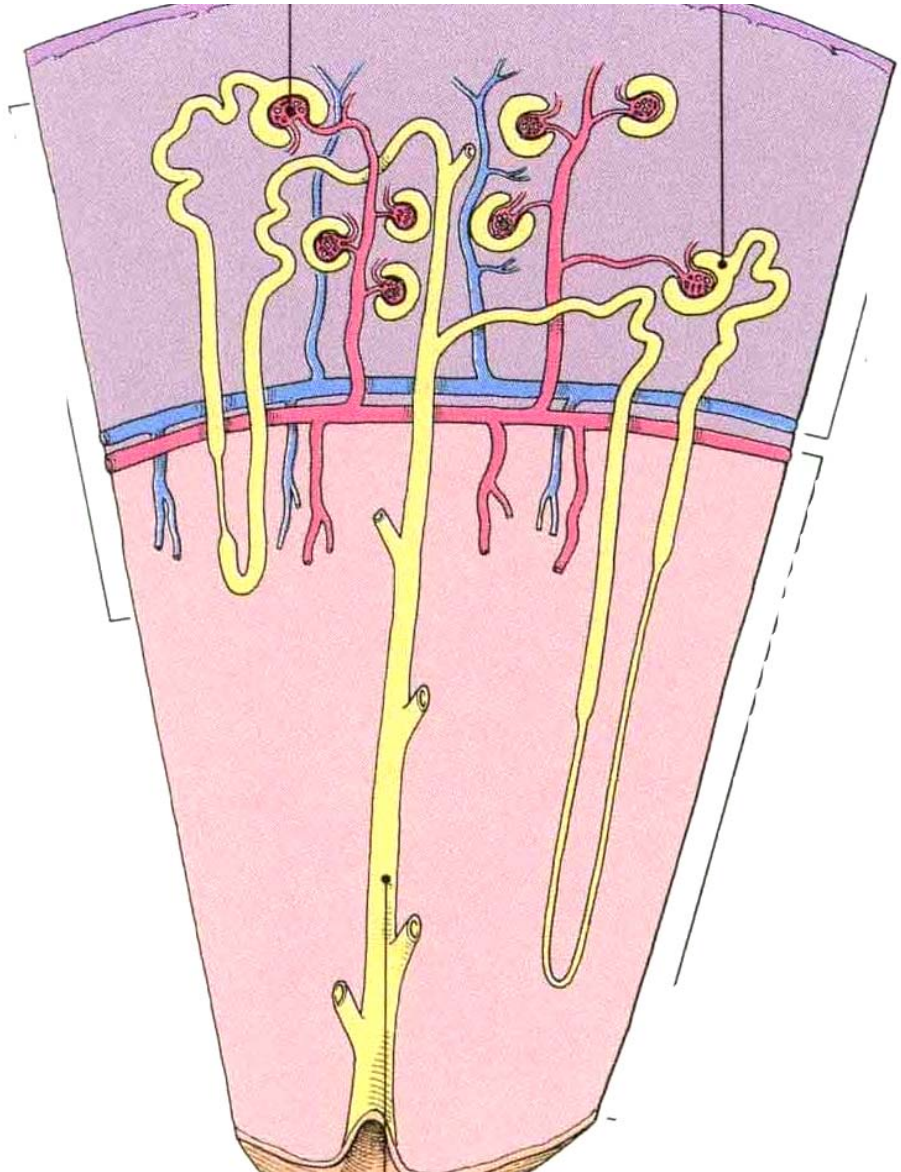
Arched collecting tubules

Cortical collecting tubules

Straight collecting tubules

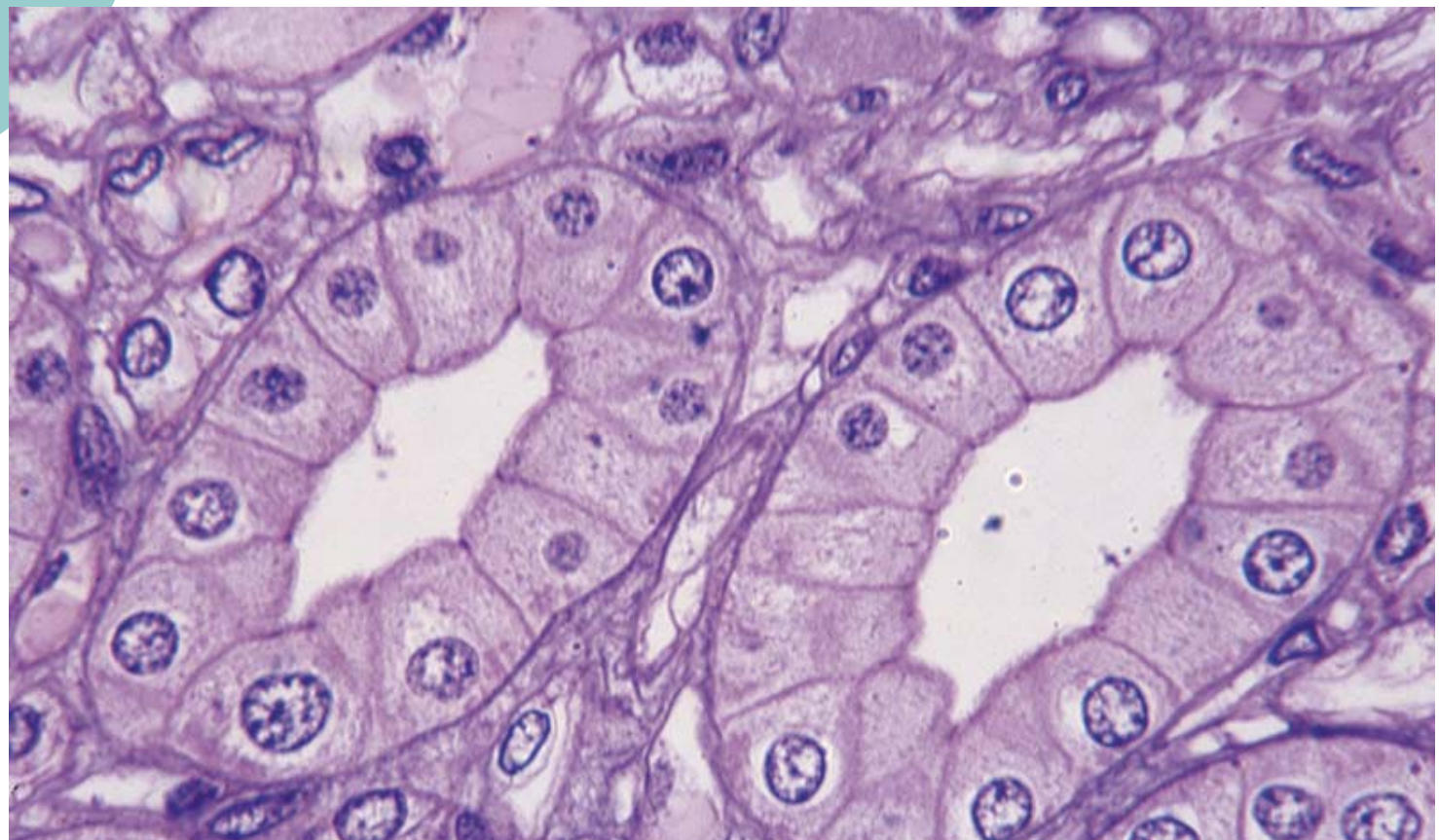
Medullary collecting tubules

Papillary ducts



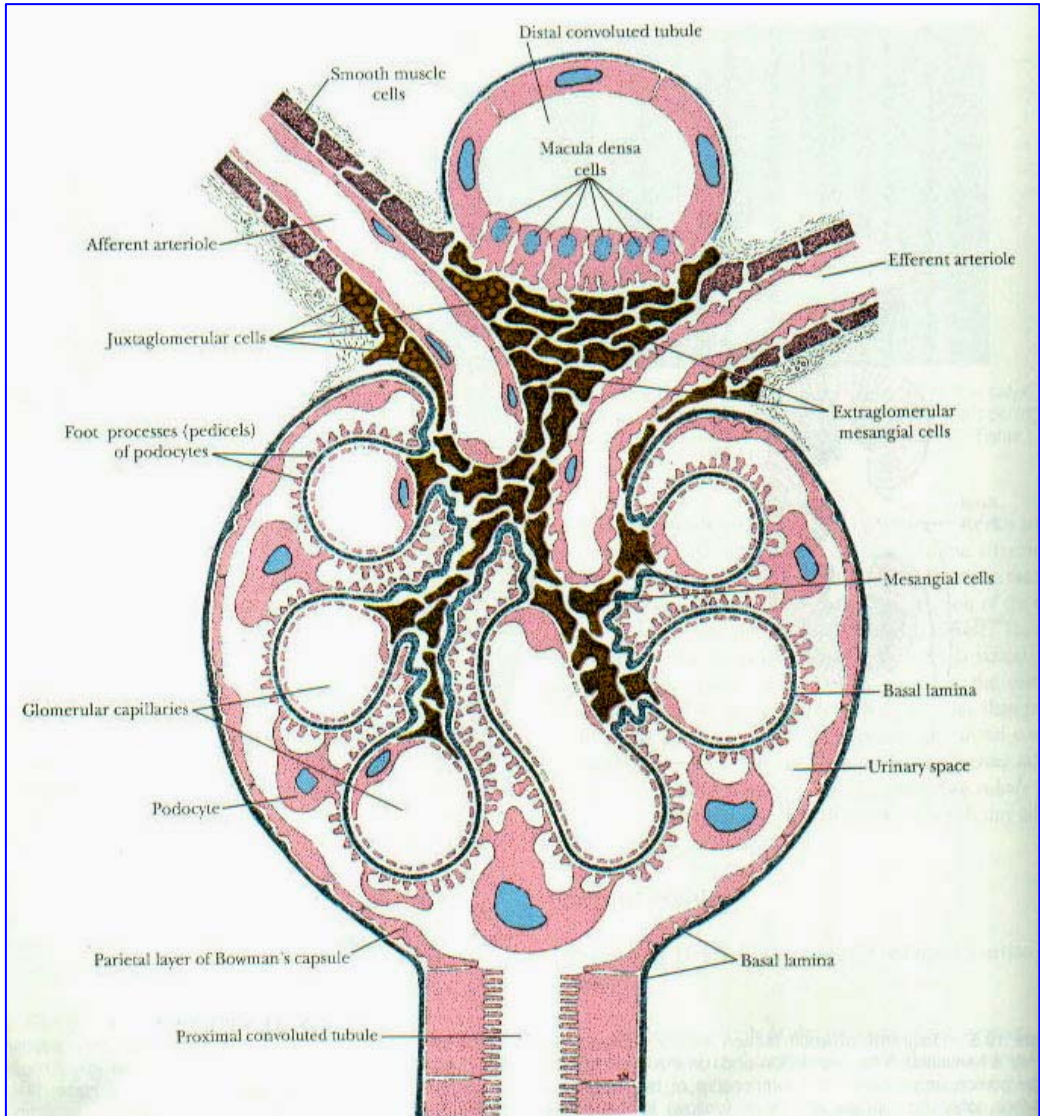
General structure and function of collecting tubules

Structure	Function
cuboidal and columnar in shape	Sensitive to antidiuretic hormone(ADH),
Clear margin between cells	absorb H_2O, concentrate urine
	Secret $H^+$and HCO_3^-,



Juxtaglomerular apparatus

- **Juxtaglomerular cells**
- **Macula densa**
- **Extraglomerular mesangial cells**



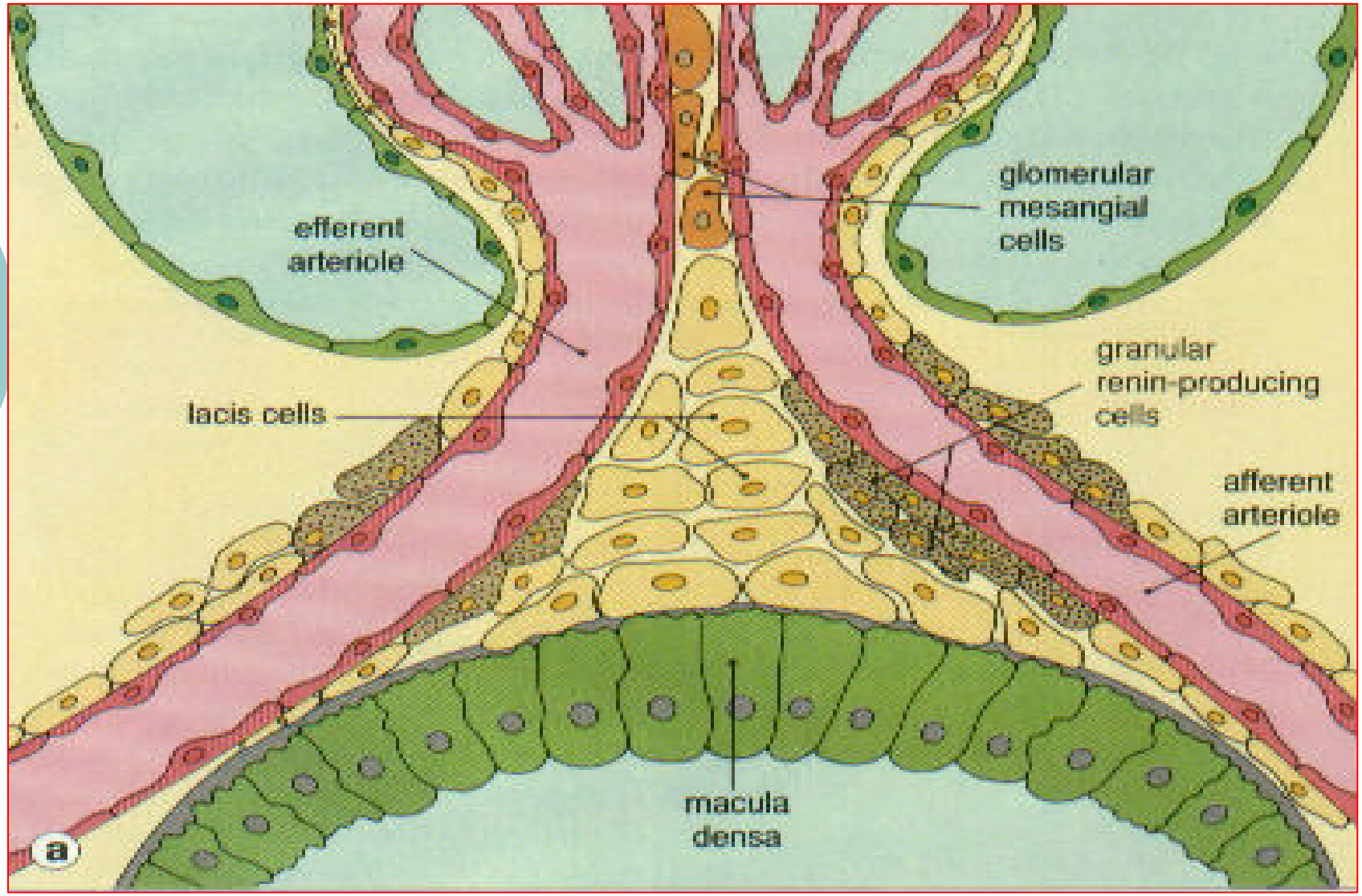
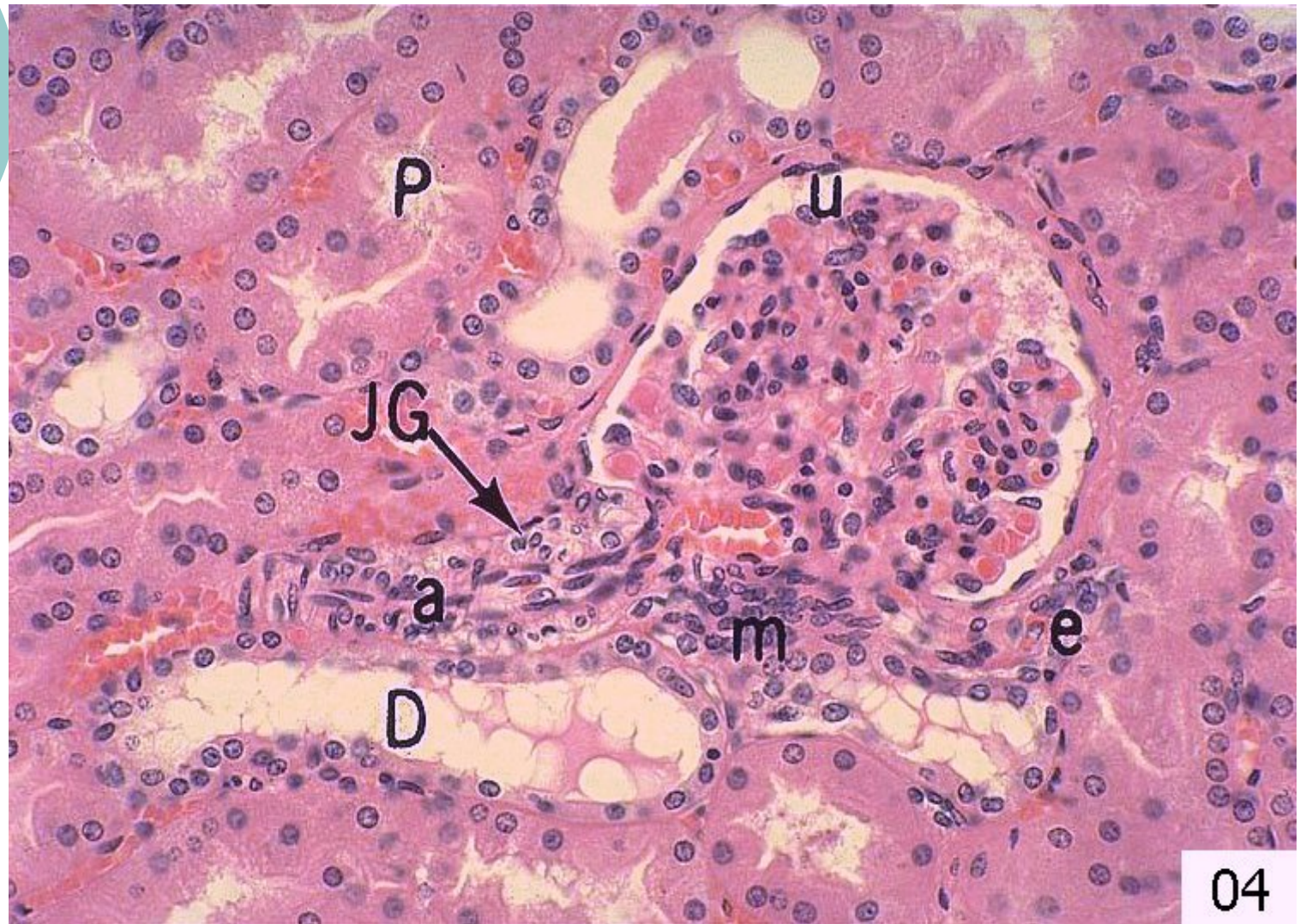
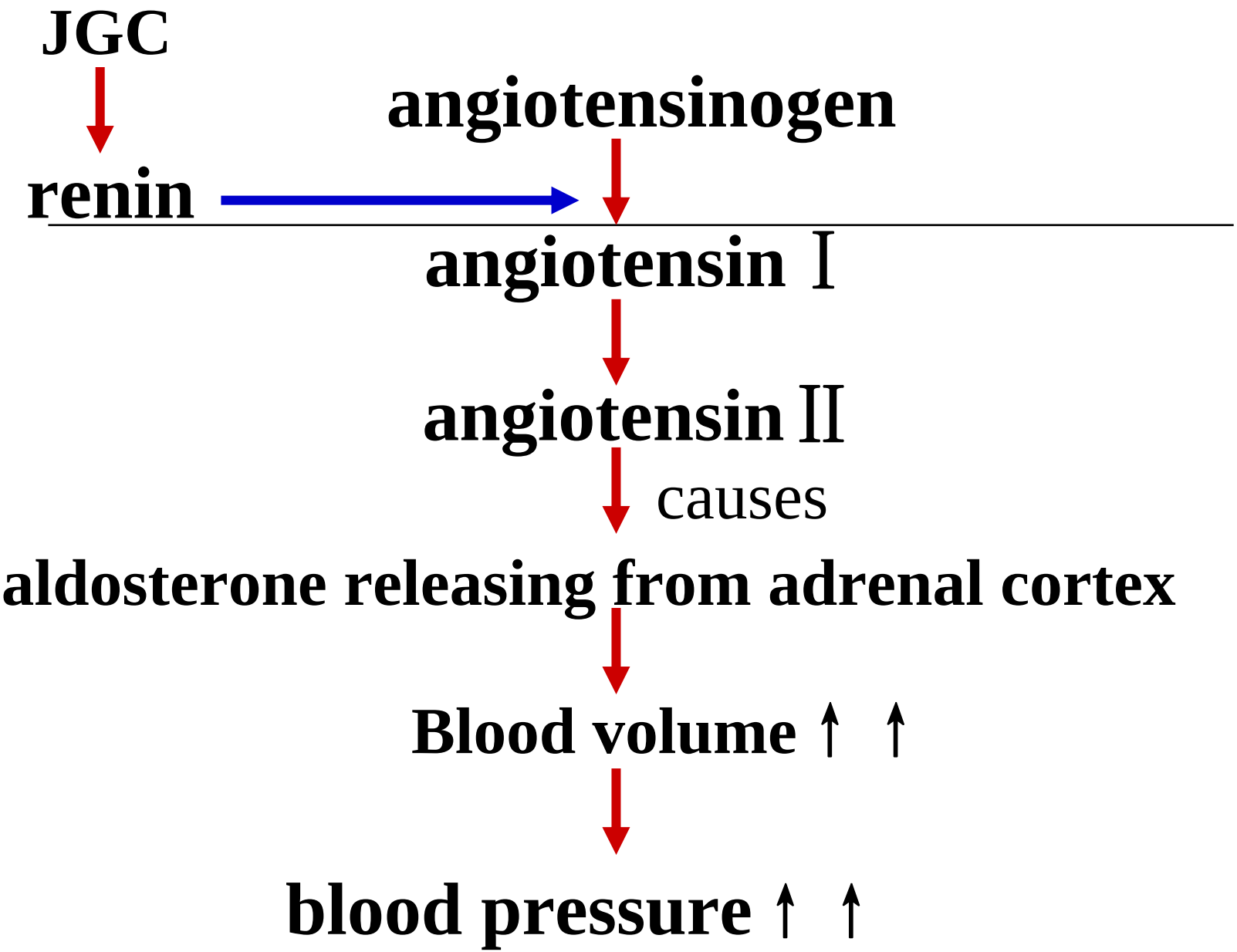


Diagram of relation of JC to macula densa and lacis cells

Juxtaglomerular cells

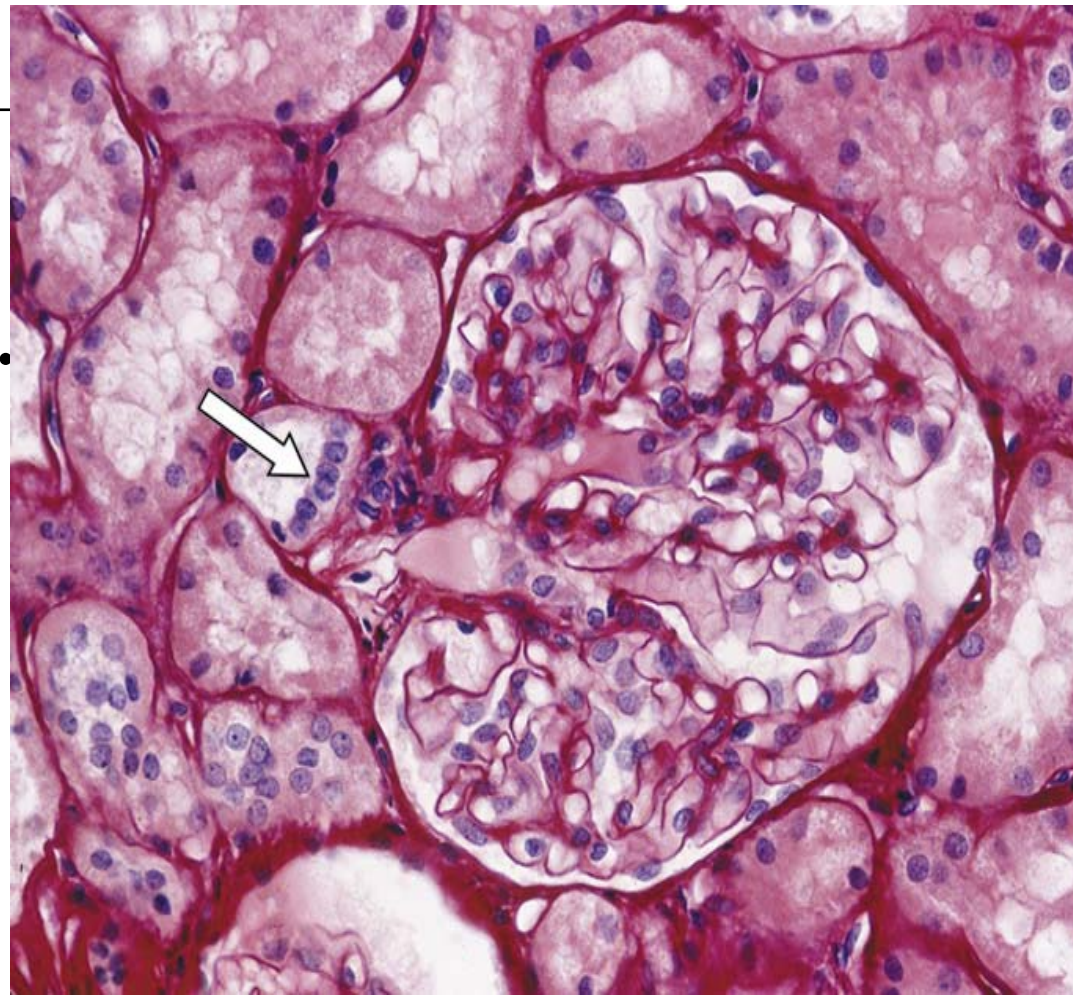



JGC
angiotensinogen
renin
angiotensin Ⅰ
angiotensin Ⅱ
causes
aldosterone releasing from adrenal cortex
Blood volume ↑ ↑
blood pressure ↑ ↑

Macula densa

origin

derive from the distal convoluted tubule cells.



features

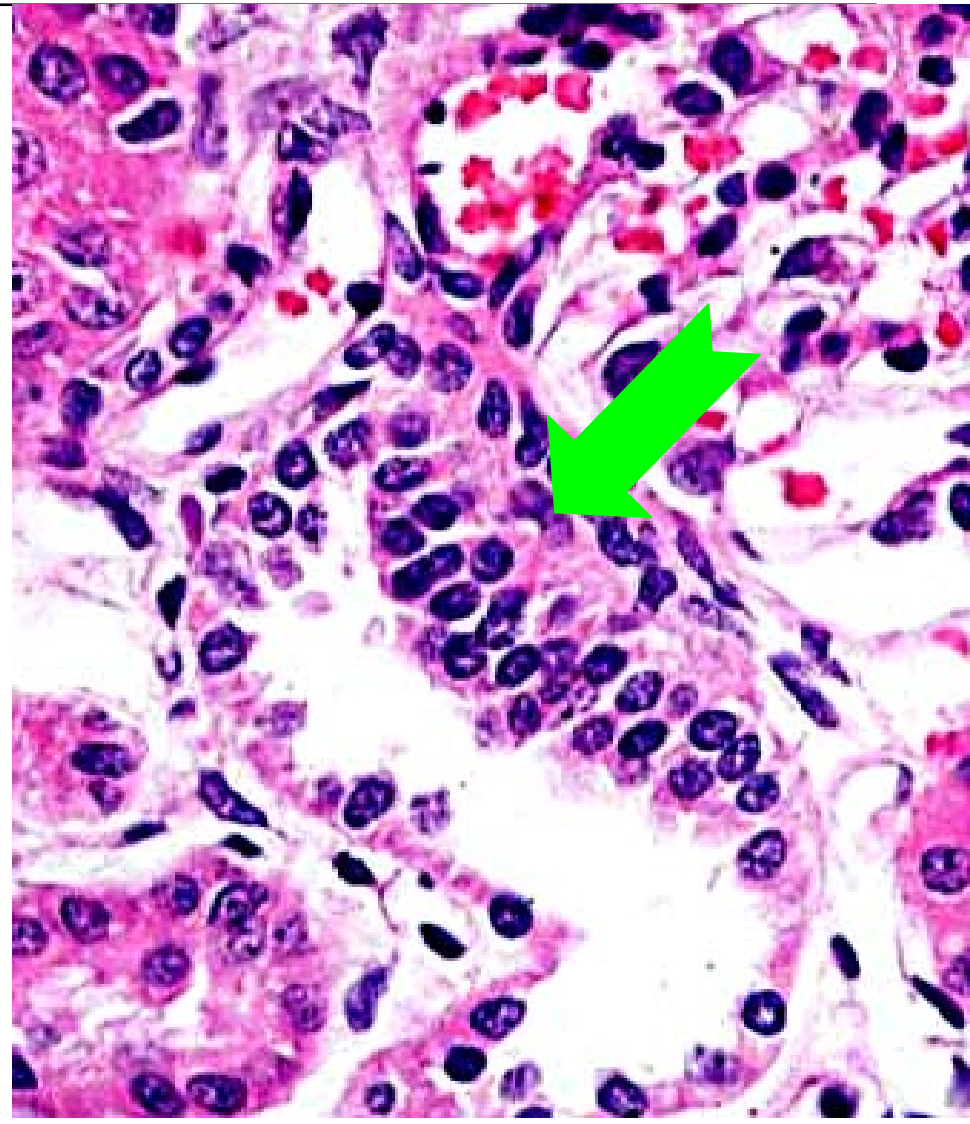
Cells are tall, narrow, close together

function

Act as a chemoreceptor, sensitive mineral level promote the realease of the enzyme renin

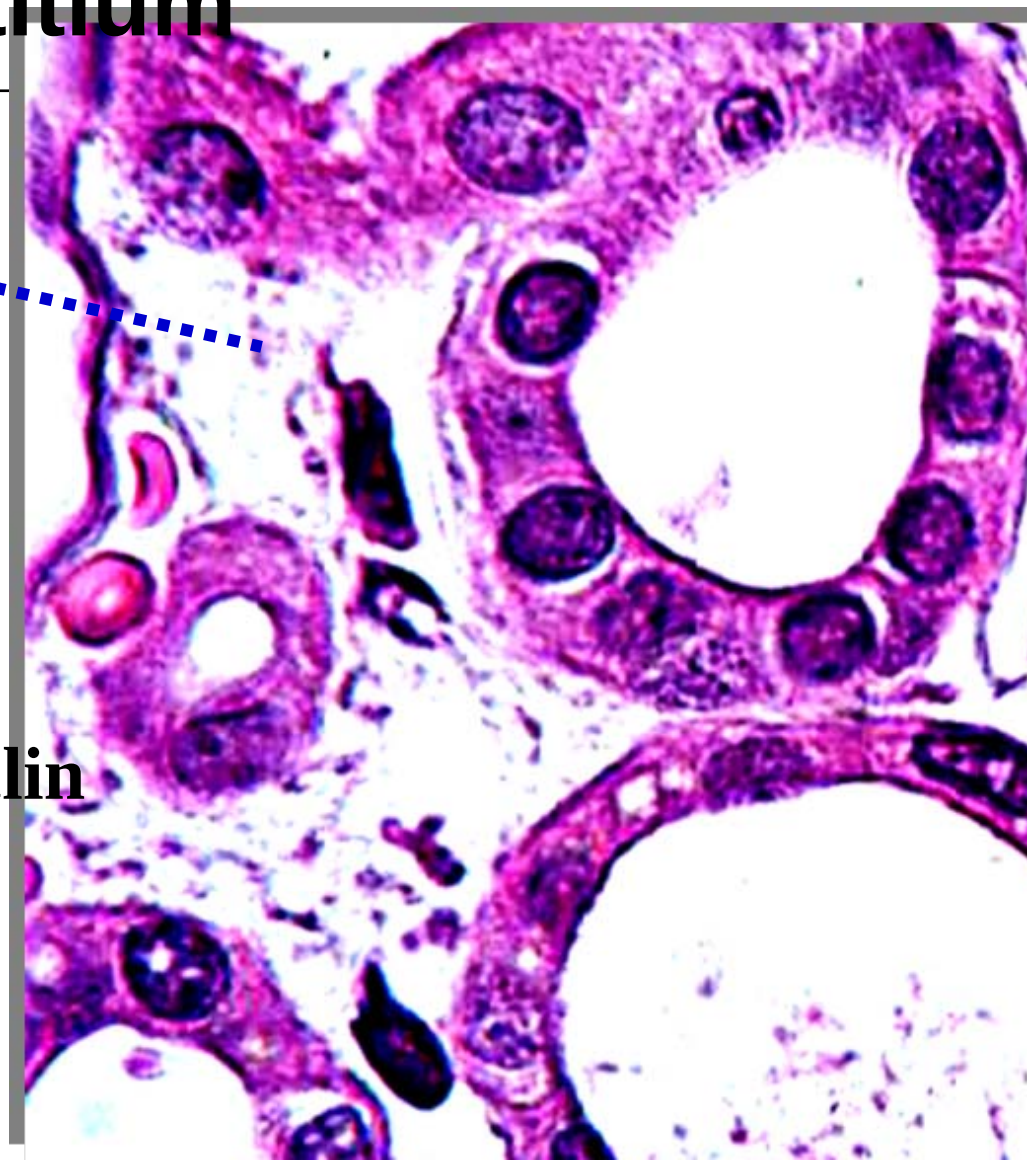
extraglomerular mesangial cells

- At the point of entry of the afferent arteriole
- No yet clarified



Renal interstitium

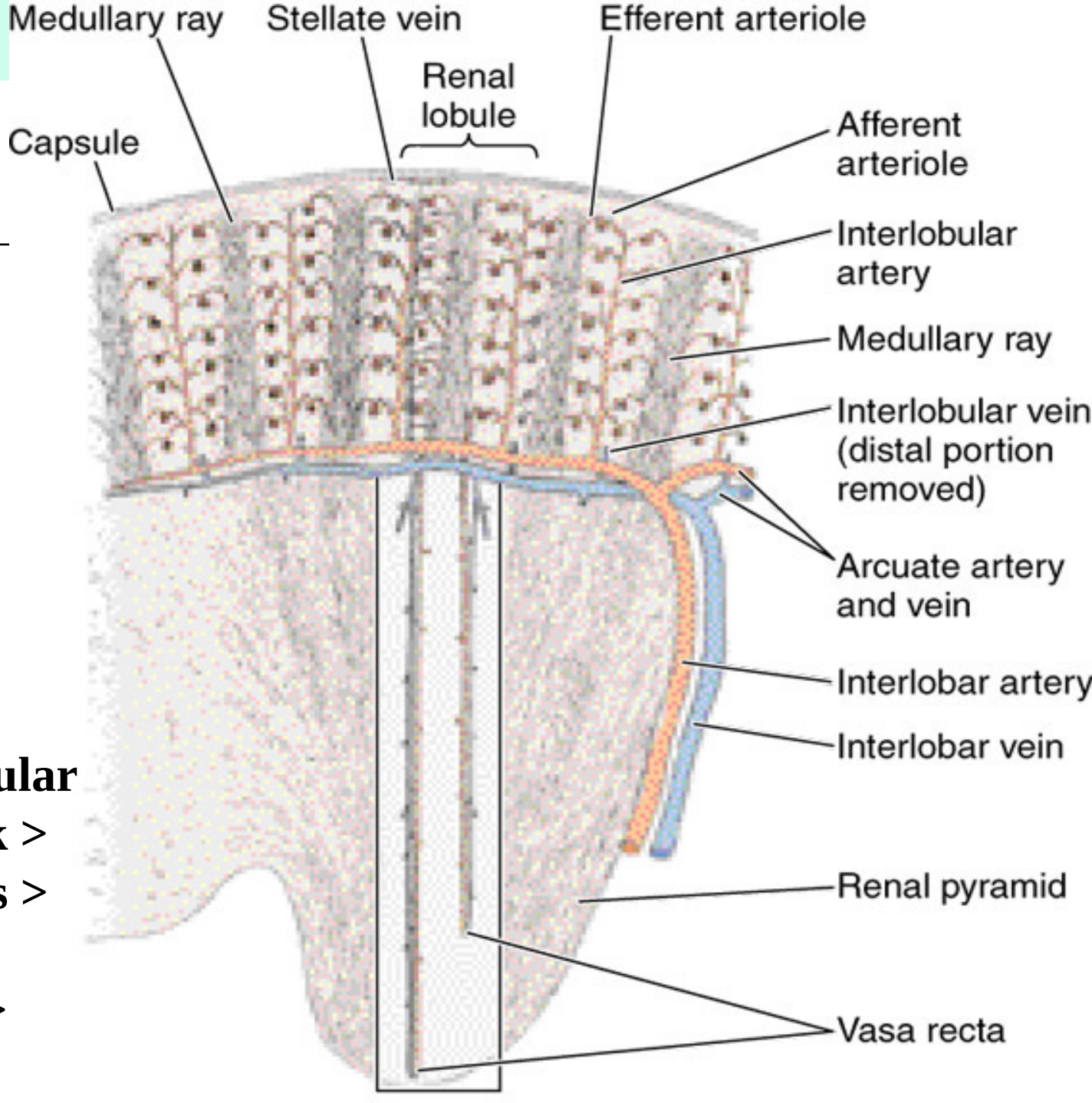
CT between renal tubules



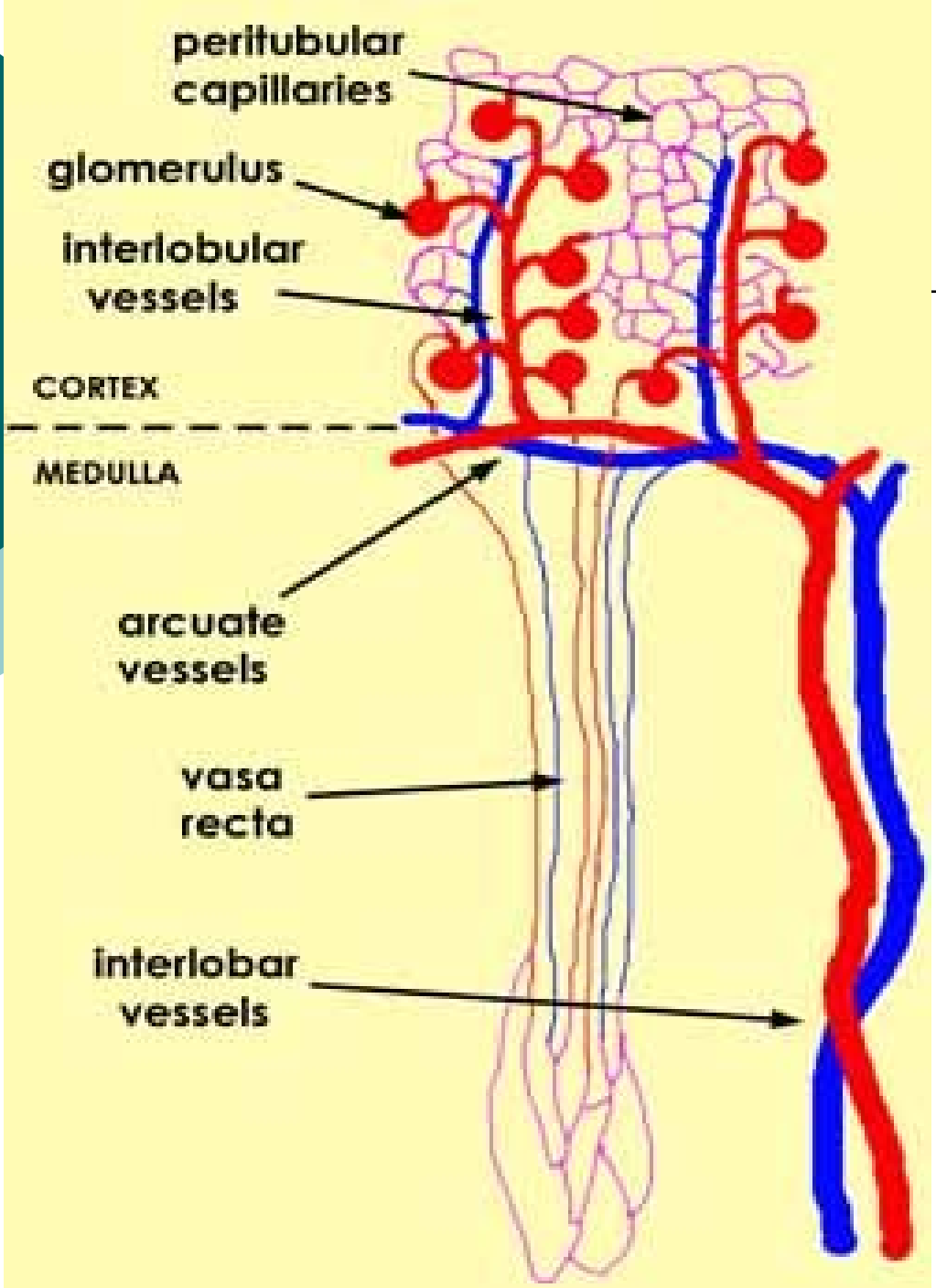
Cells in the interstitium

1.interstitial cells
prostaglandins , prostacyclin
2.fibroblast
3.macrophage

Blood supply



Venous: Peritubular capillary network > interlobular veins > arcuate veins > interlobar veins > renal vein.



Arterial: renal artery > inter-lobar arteries > arcuate arteries > inter-lobular arteries > afferent arterioles > renal corpuscle (capillaries!) > efferent arteriole > peritubular capillary network (for cortical nephrons) --or-- > vasa recta (for juxtamedullary nephrons).