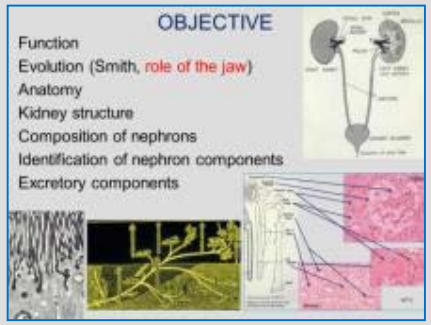
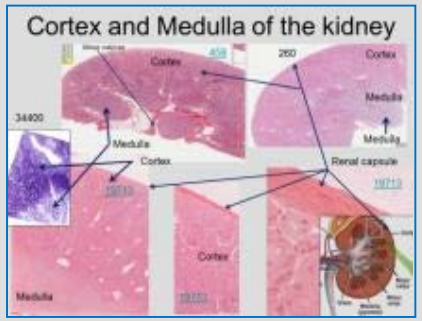
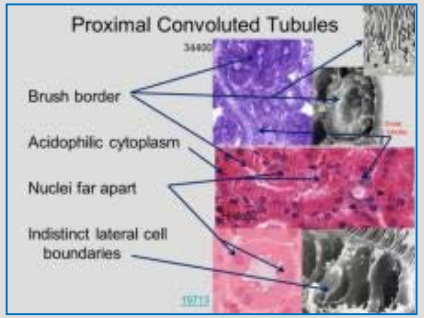
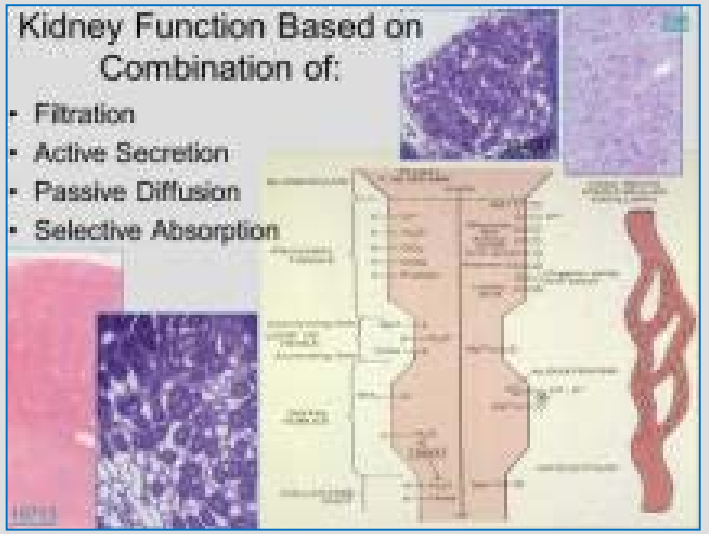
Medical School Histology Basics
Urinary System

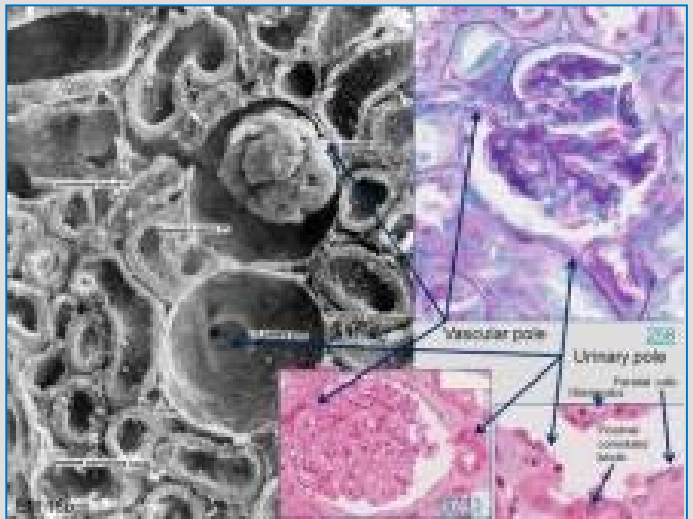
VIBS 243 lab

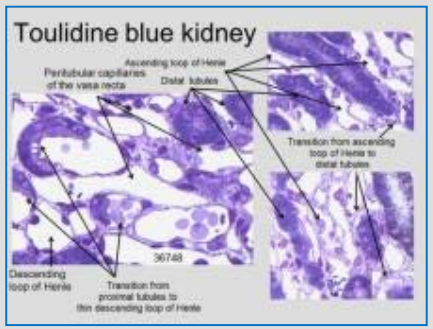


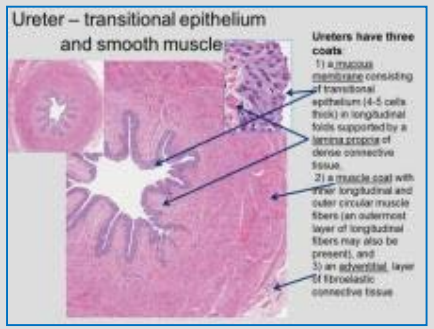


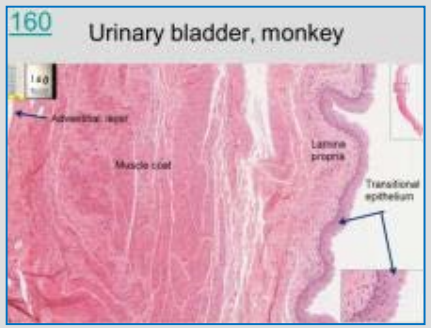












Larry Johnson Texas A&M University

OBJECTIVE

Function

Evolution (Smith, role of the jaw)

Anatomy

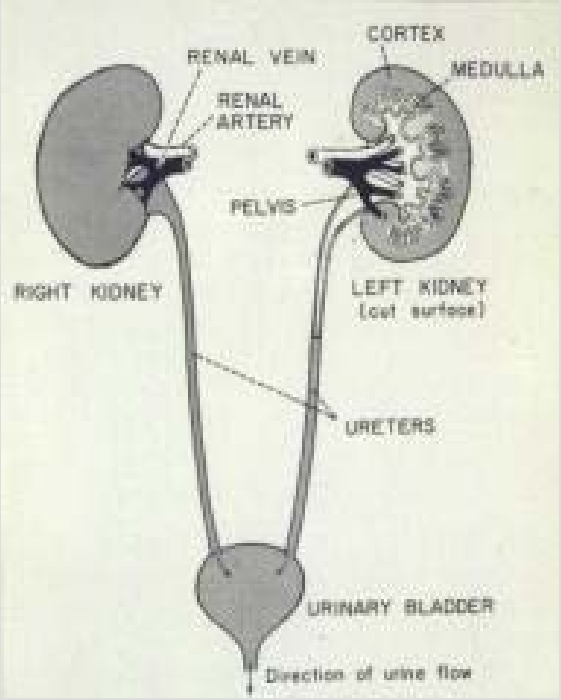
Kidney structure

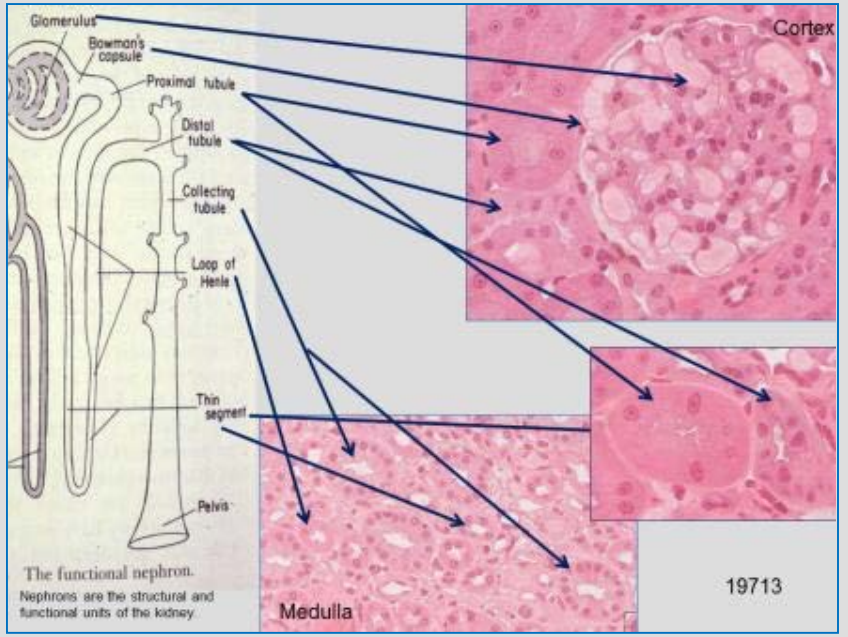
Composition of nephrons

Identification of nephron components

Excretory components

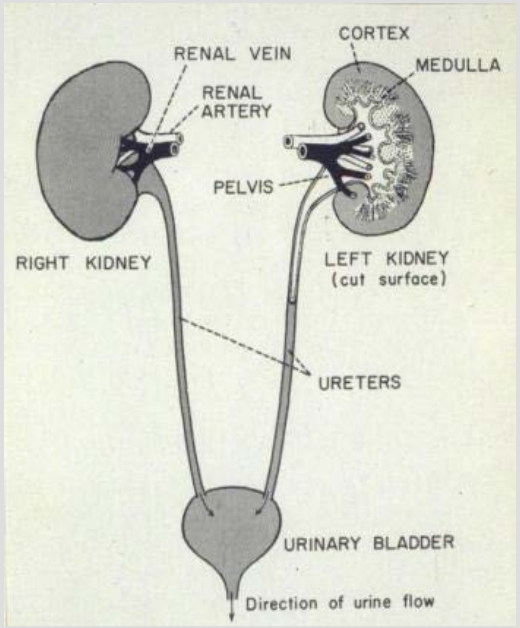
Ref code
6, 8

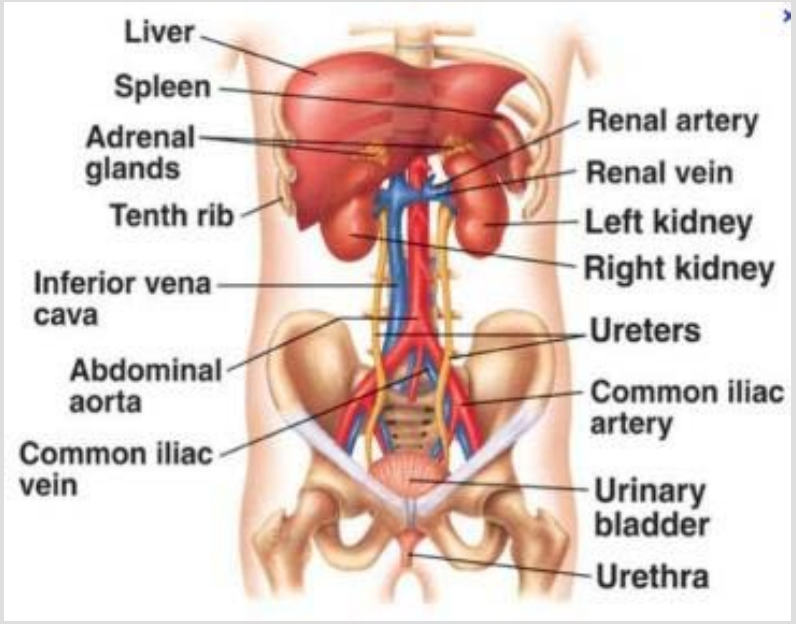




Function of Urinary System: Homeostasis

Ref code # 8





Rid body of waste (urea, uric acid, creatinine, salts)

Preserves constancy of extracellular fluid in composition, volume, and pH

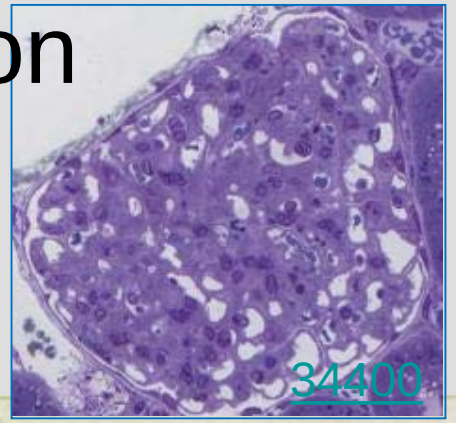
Endocrine function

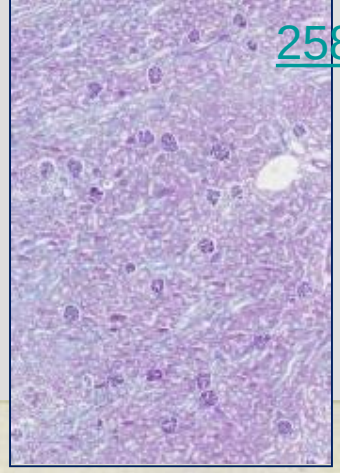
a) Secrete erythropoietin - red blood cell production

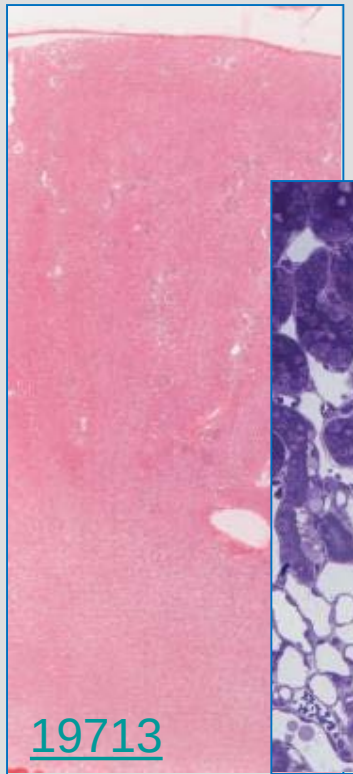
b) Produces renin - aldosterone release

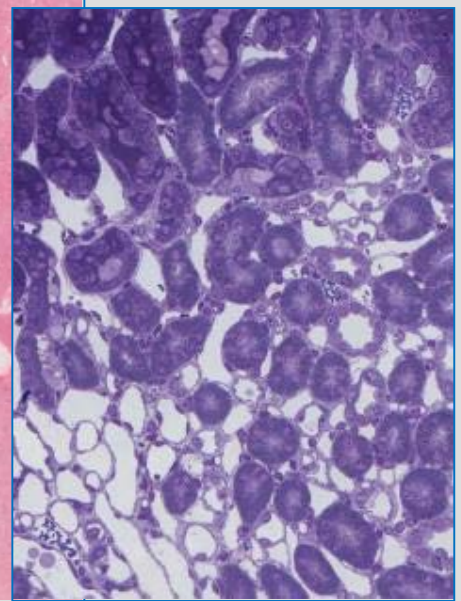
Kidney Function Based on Combination of:

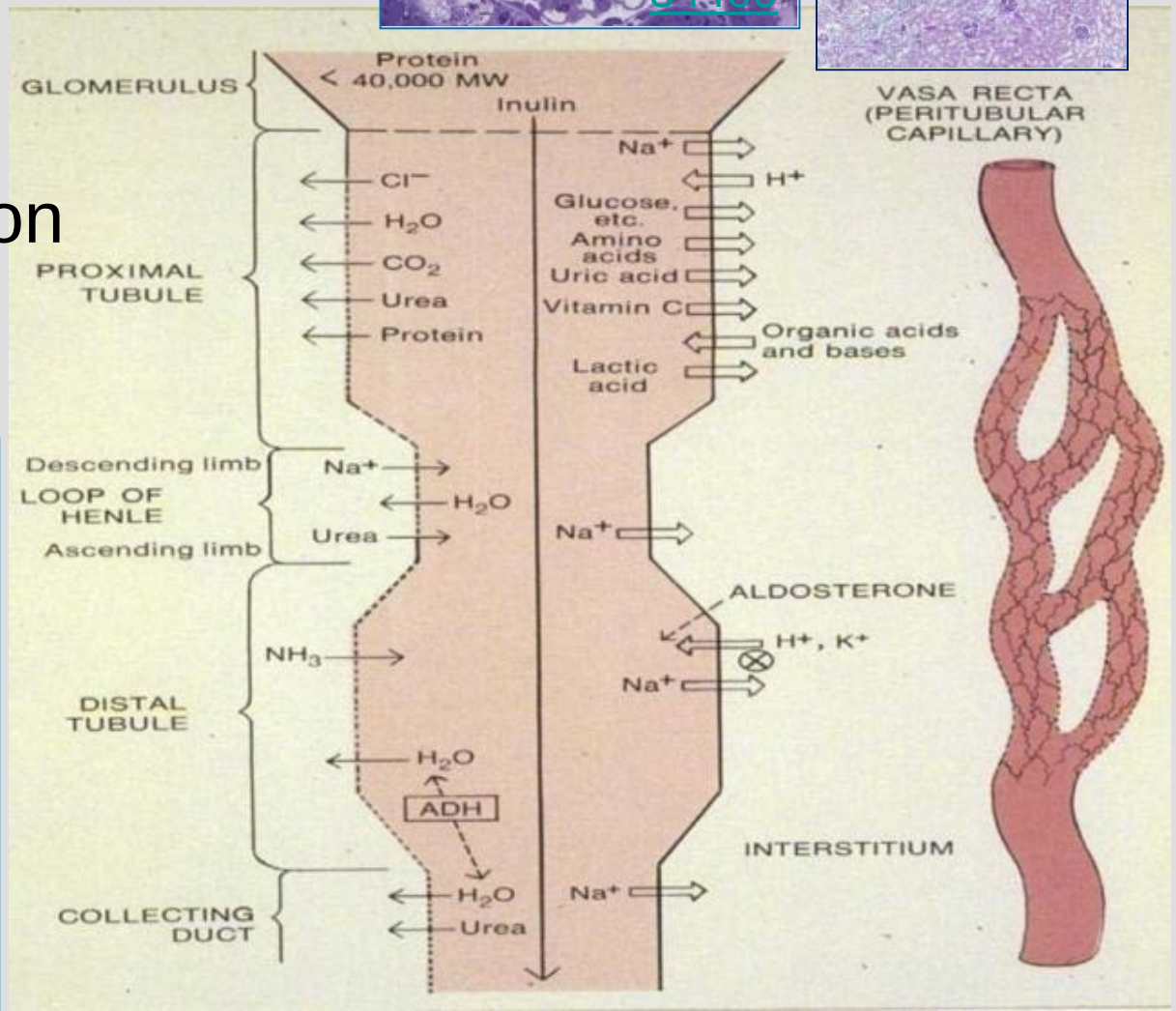
- Filtration
- Active Secretion
- Passive Diffusion
- Selective Absorption











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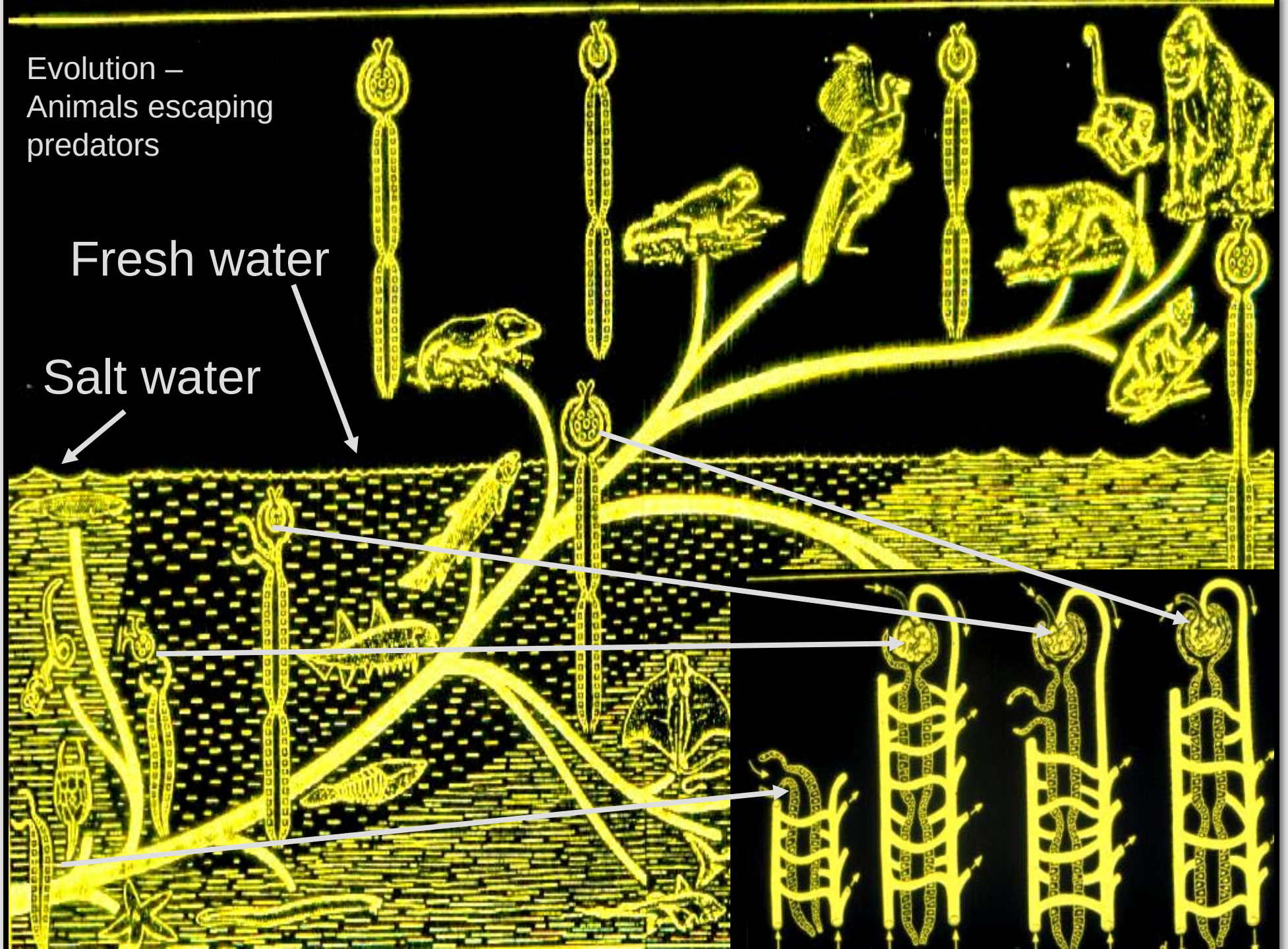

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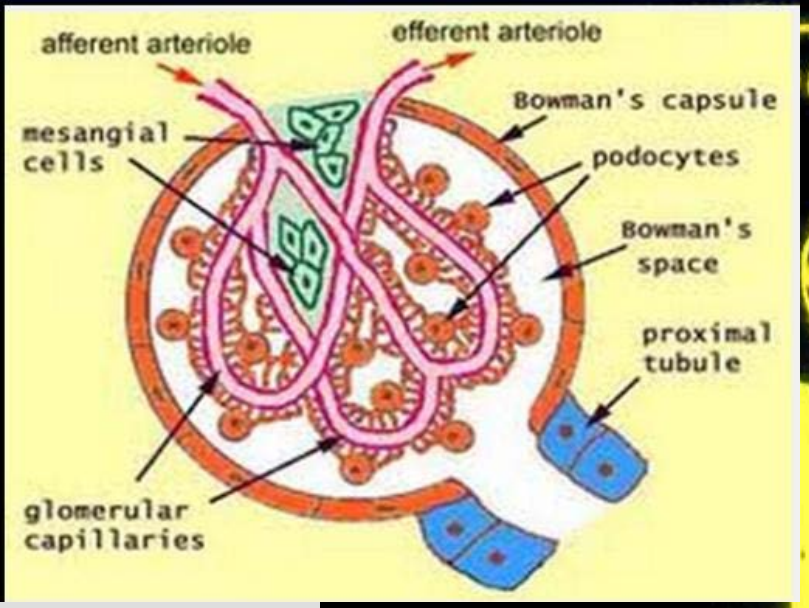

PORTAL ARTERIOLE

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Portal system

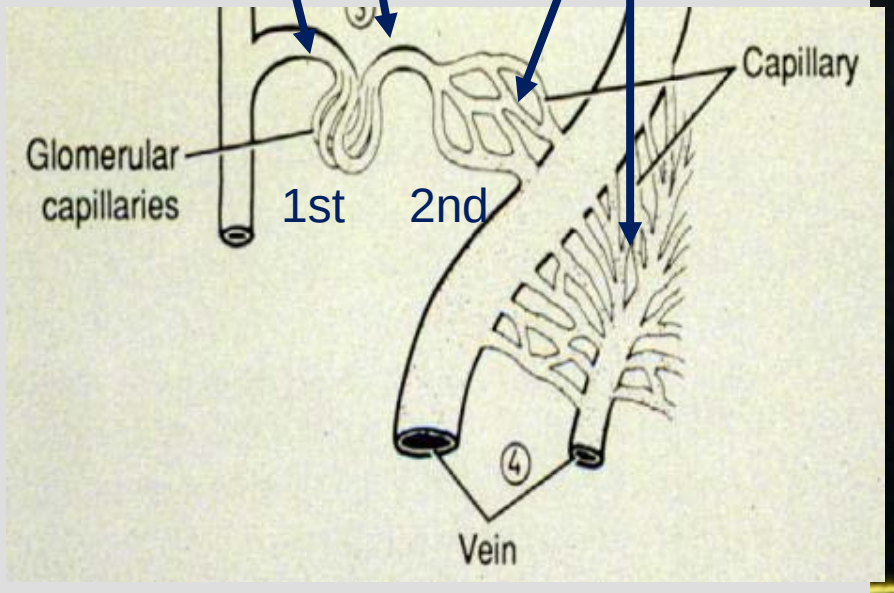
= CAPILLARY ⇨ PORTAL ARTERIOLE ⇨ CAPILLARY

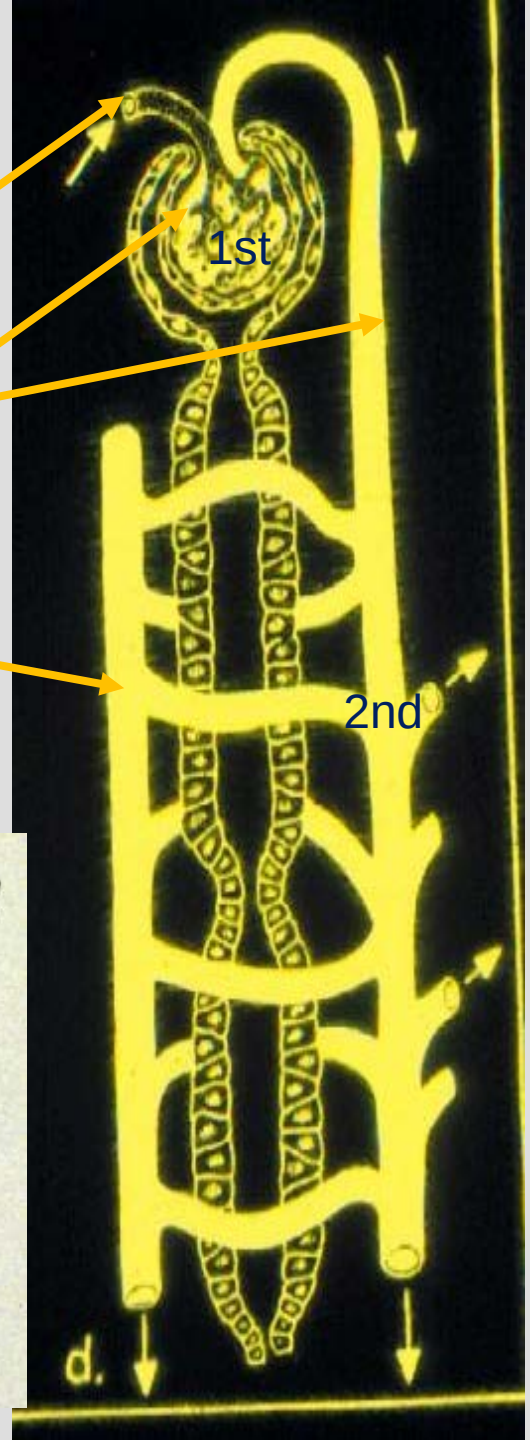
afferent ARTERIOLE

Glomerular CAPILLARY

efferent ARTERIOLE

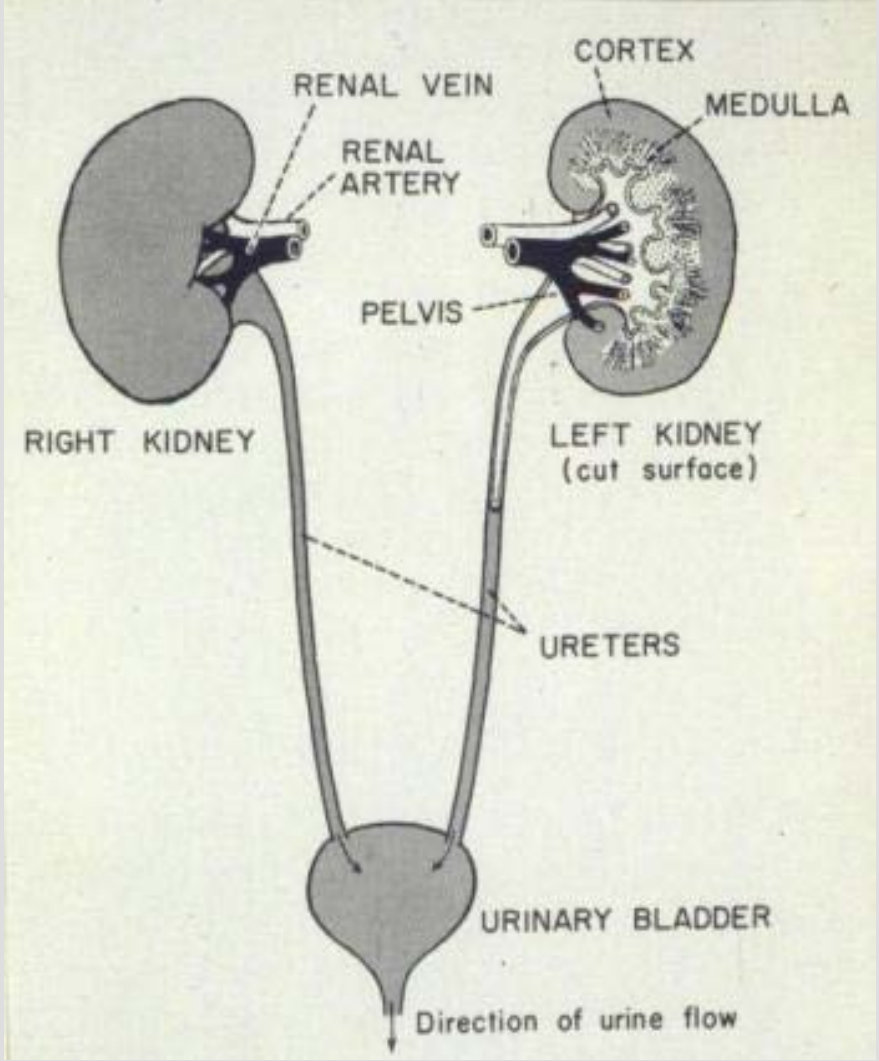
PERITUBULAR CAPILLARIES

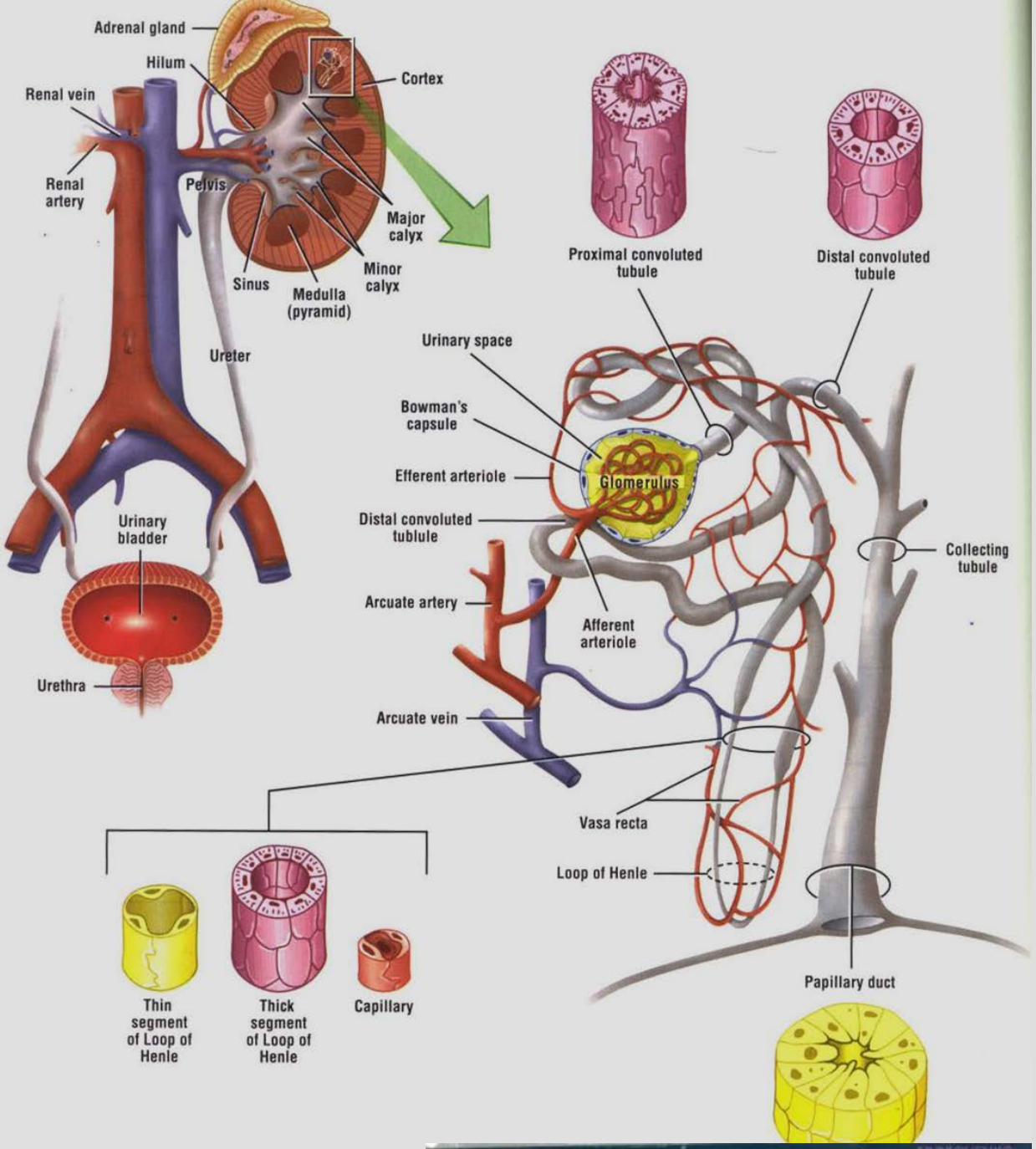




Function of a portal system?

local change in blood composition whereby the first capillary modifies and second allows the change in composition to affect local cells near it.





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di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS
EROSCHENKO

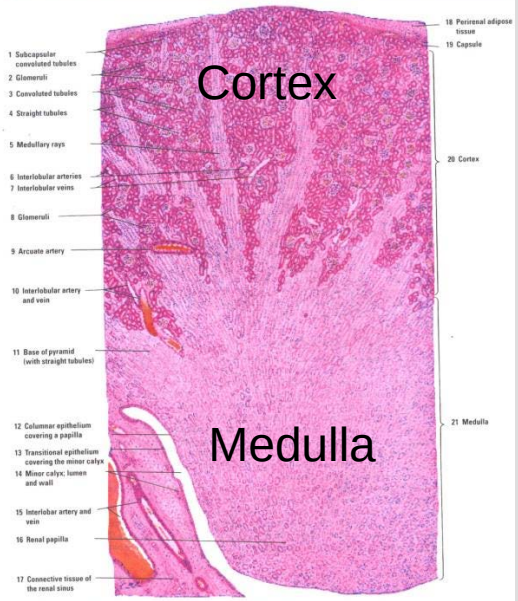
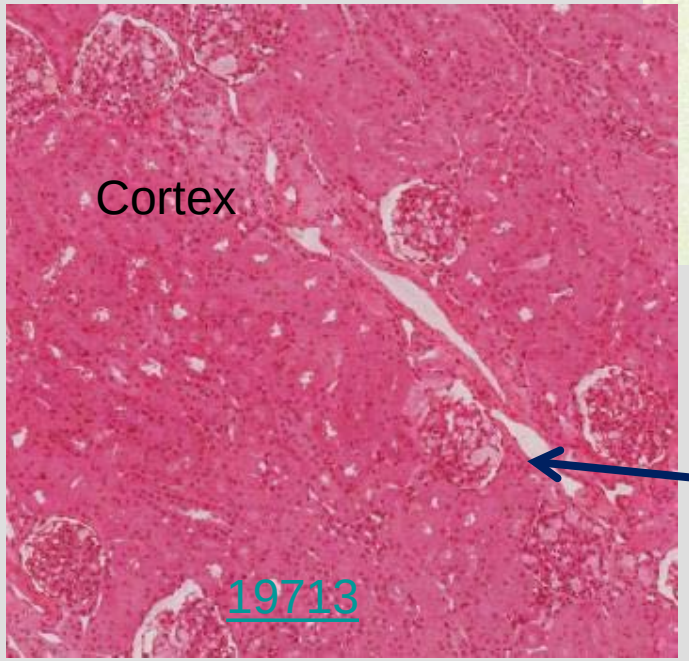
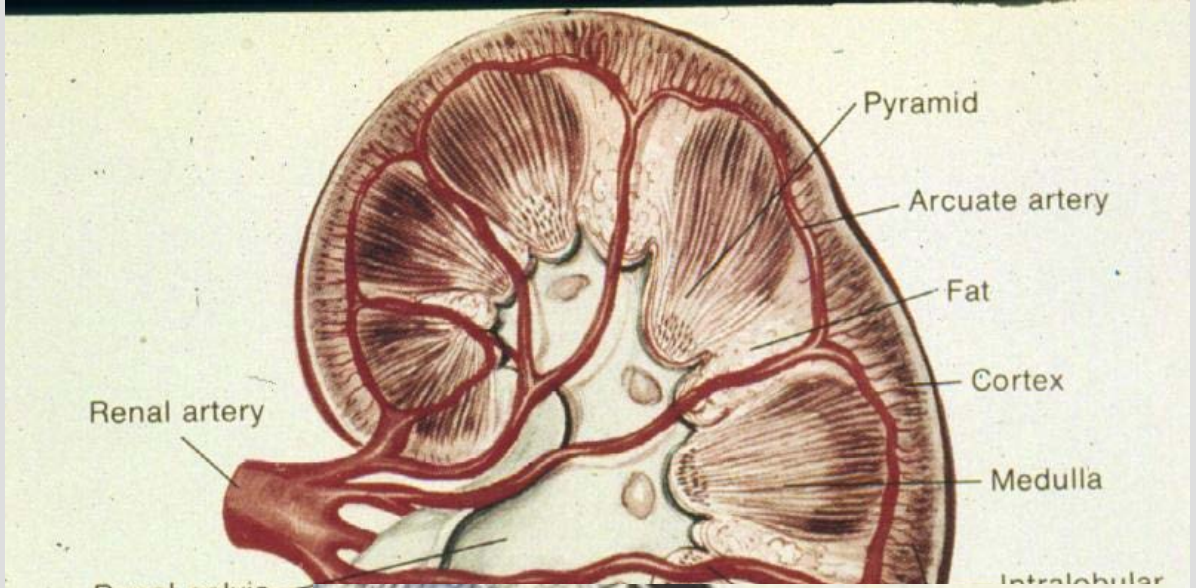
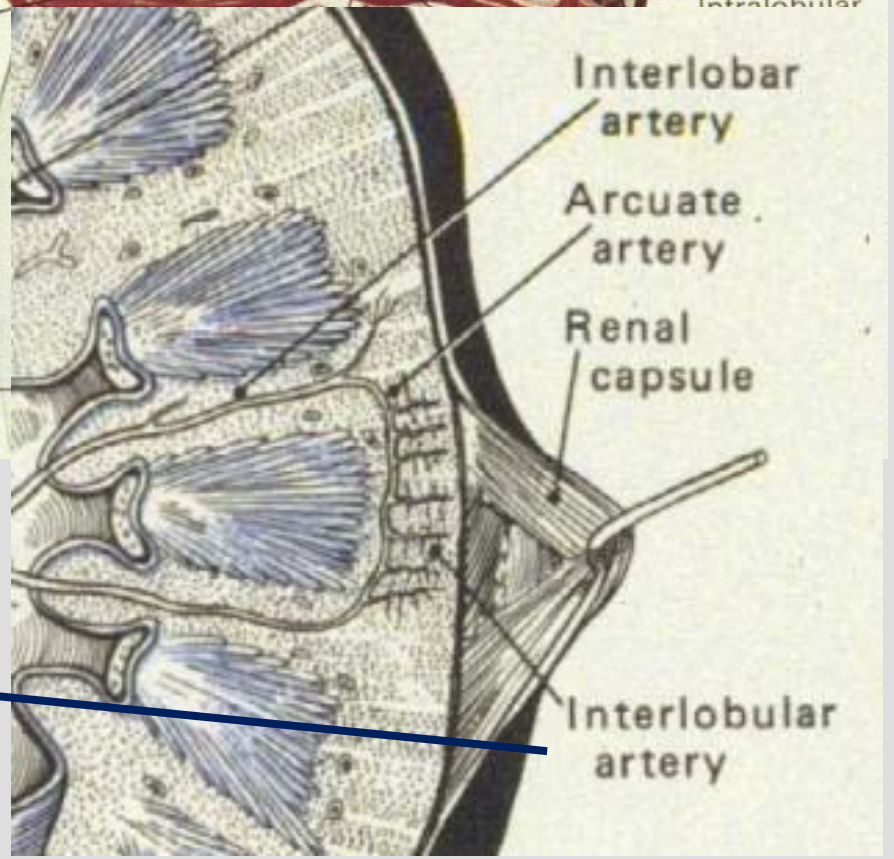


Fig. 15-1 Kidney: Cortex and Pyramid (panoramic view). Stain: hematoxylin-eosin. Low magnification.

di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIO







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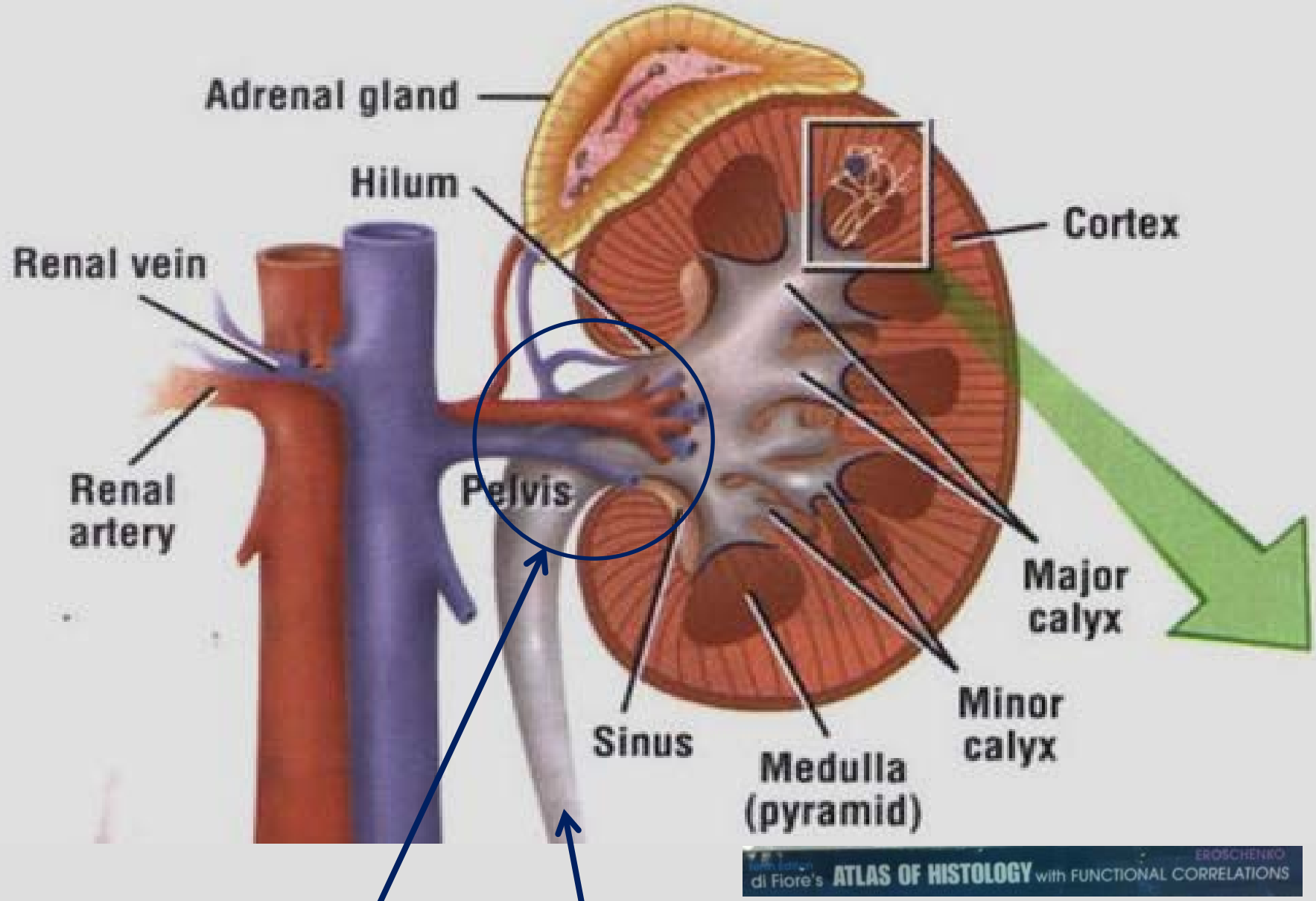
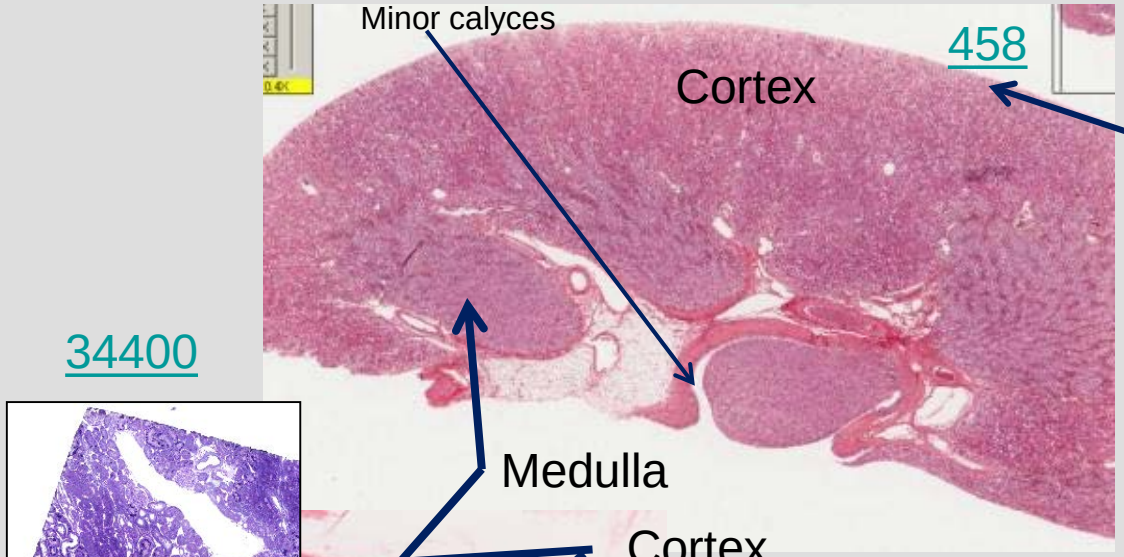
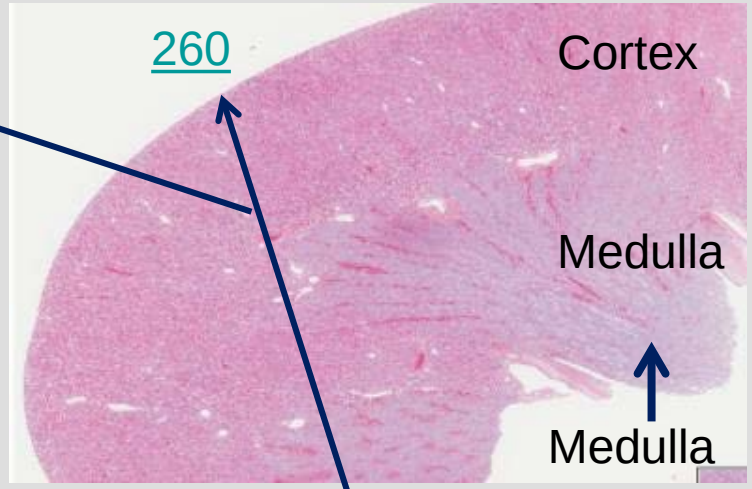


Hilus region where blood vessels enter and leave and the ureter begins

Cortex and Medulla of the kidney

Ref code # 5





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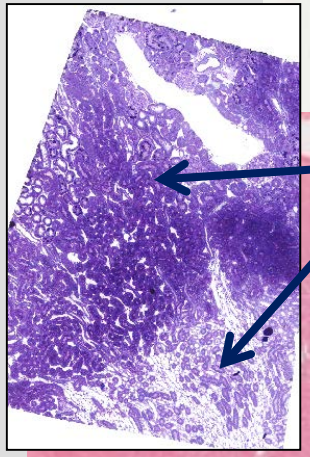

Cortex

Renal capsule

19713

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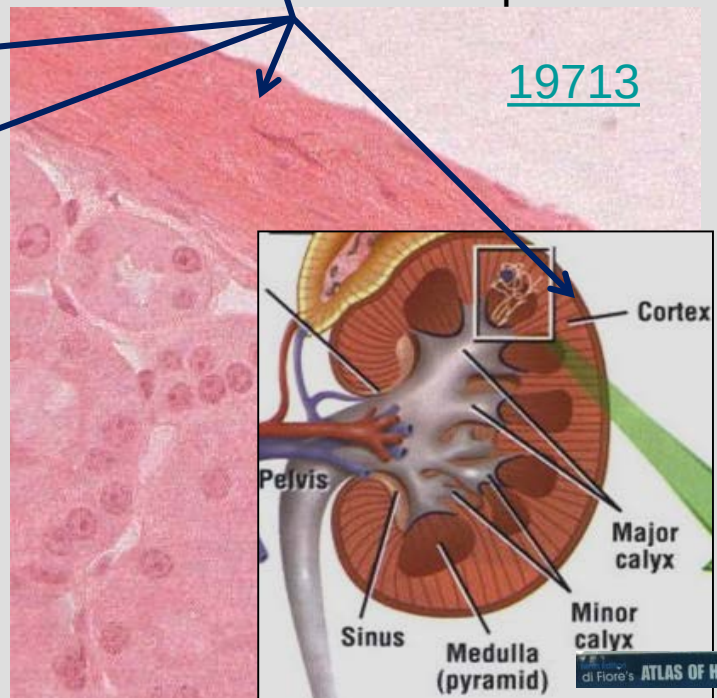
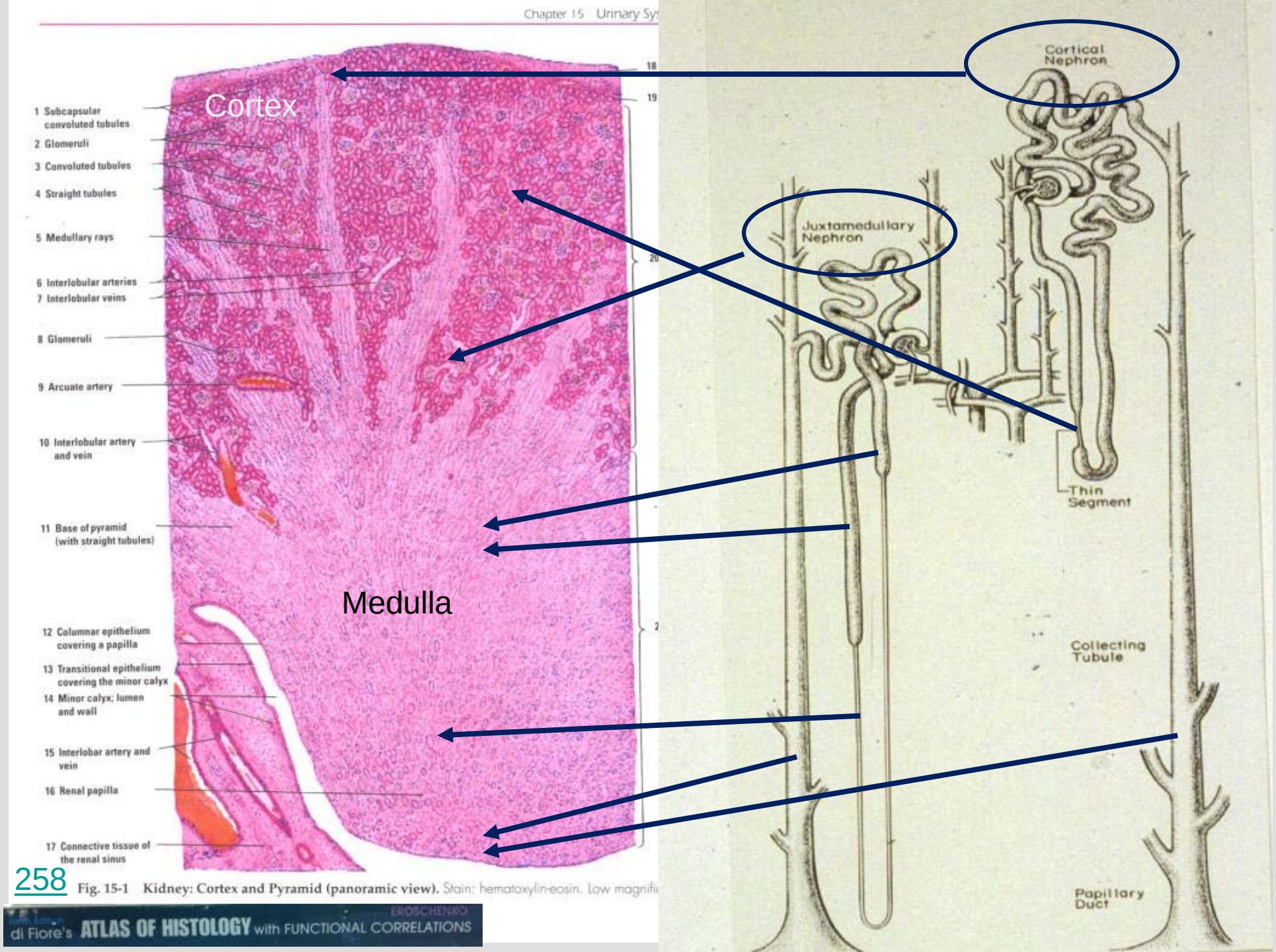


EROSCHENKO di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS



258 Fig. 15-1 Kidney: Cortex and Pyramid (panoramic view). Stain: hematoxylin-eosin. Low magnifi

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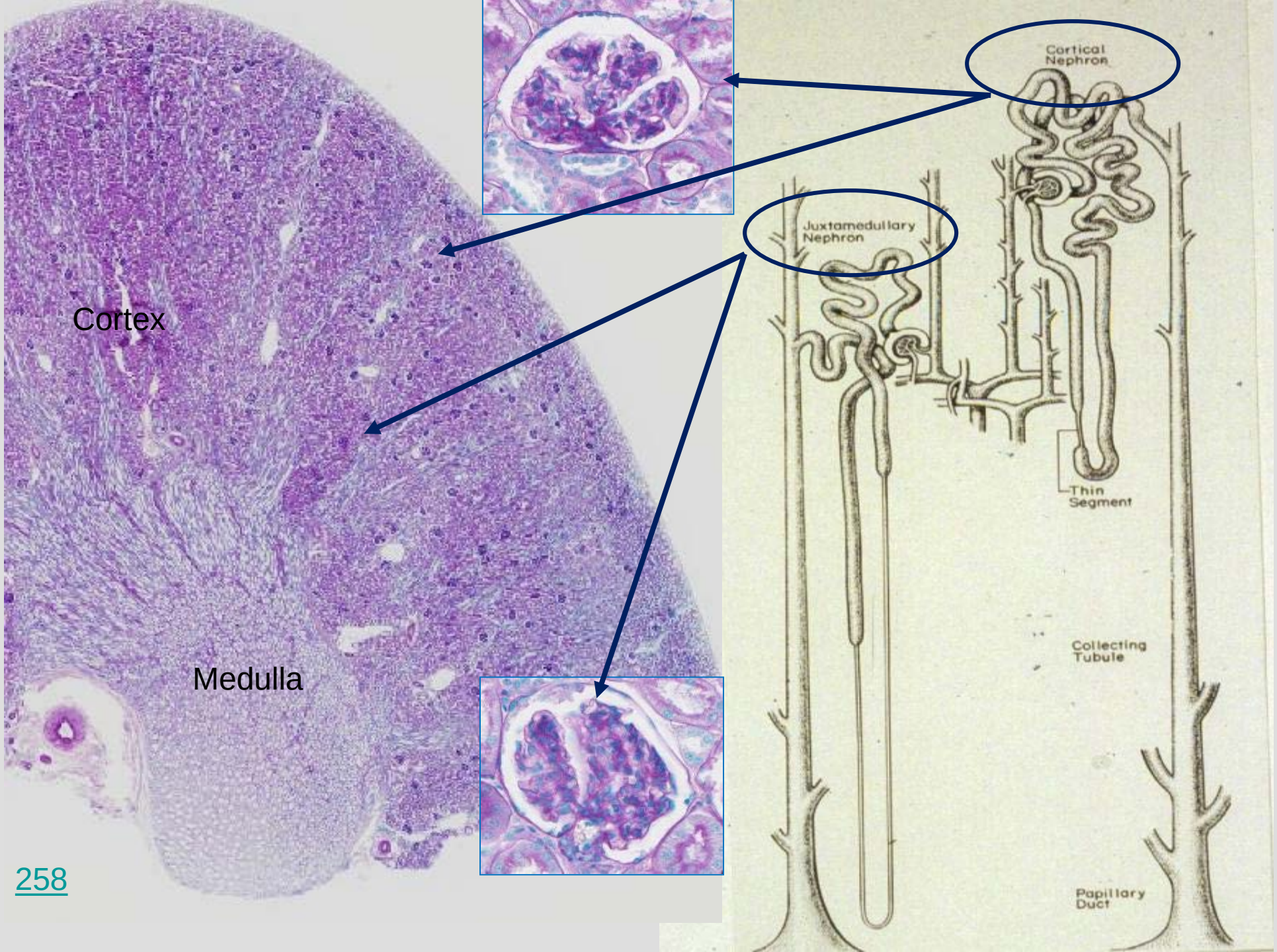

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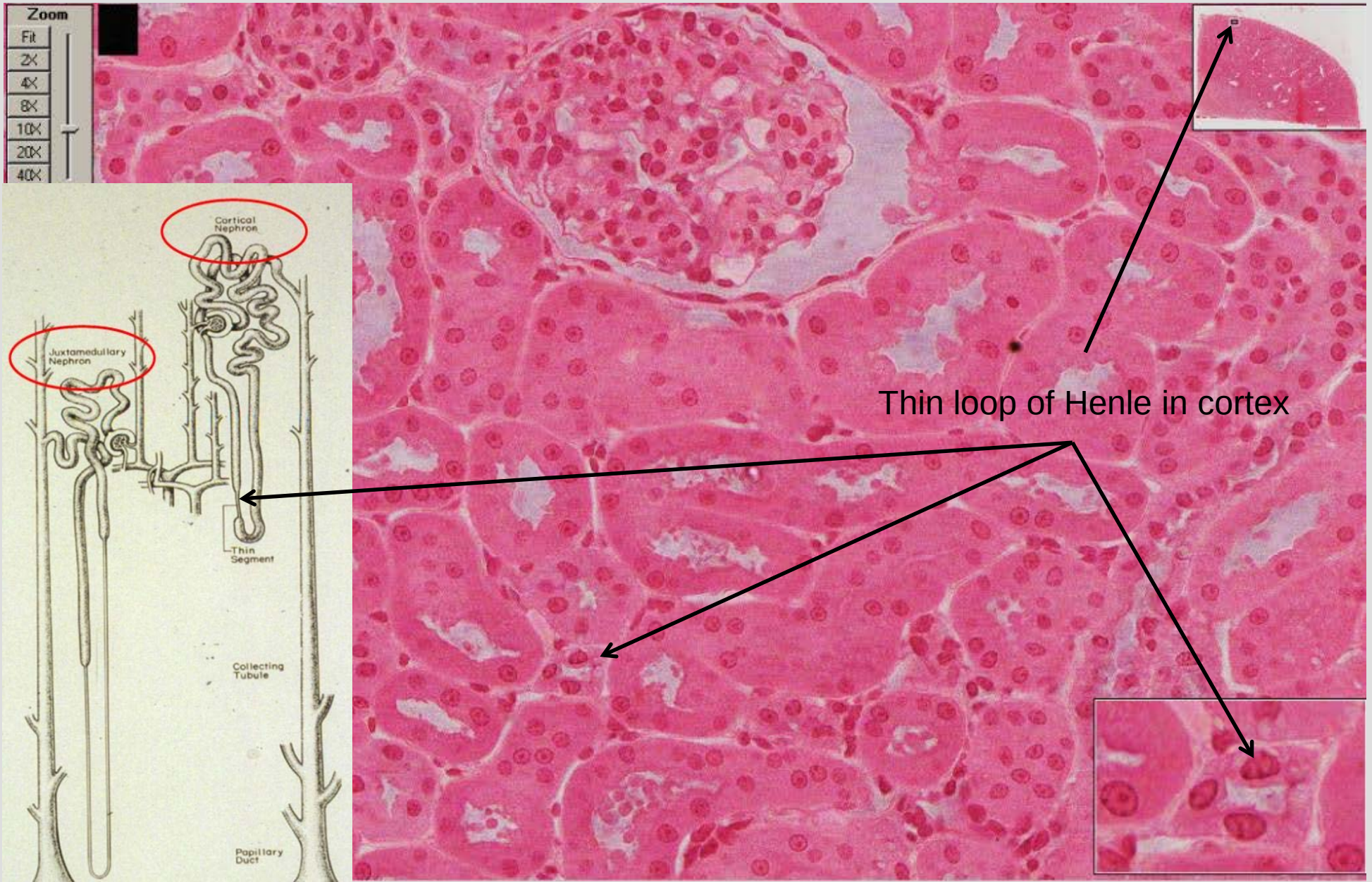
258

19713 kidney thin loop of Henle in cortex

Ref code # 6



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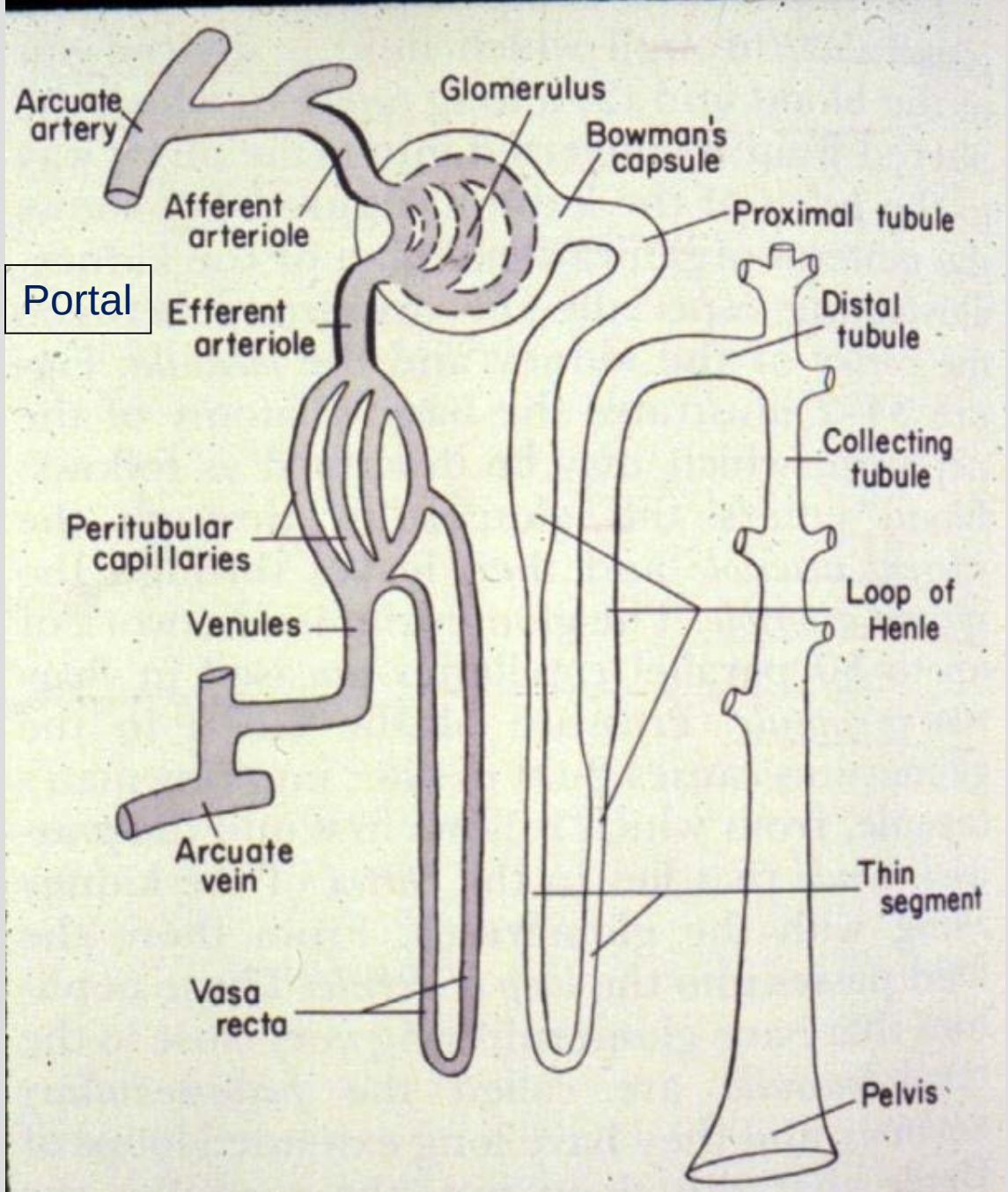


Figure 34–3 The functional nephron.

Nephrons are the structural and functional units of the kidney.

Nephrons consists of:

- A glomerulus,
- Bowman's capsule,
- proximal convoluted tubule,
- loop of Henle,
- distal convoluted tubule, and
- collecting tubule (collecting ducts).

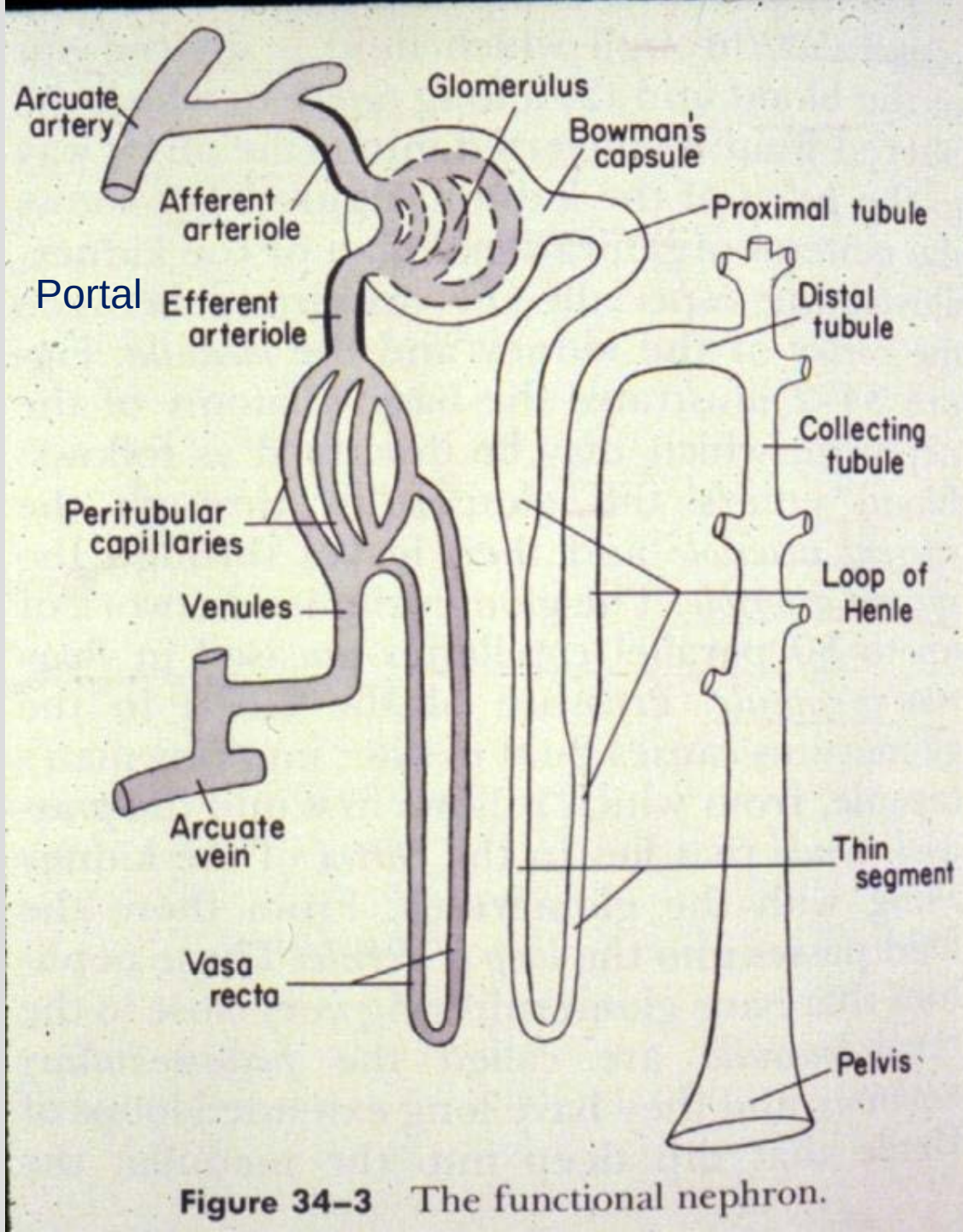
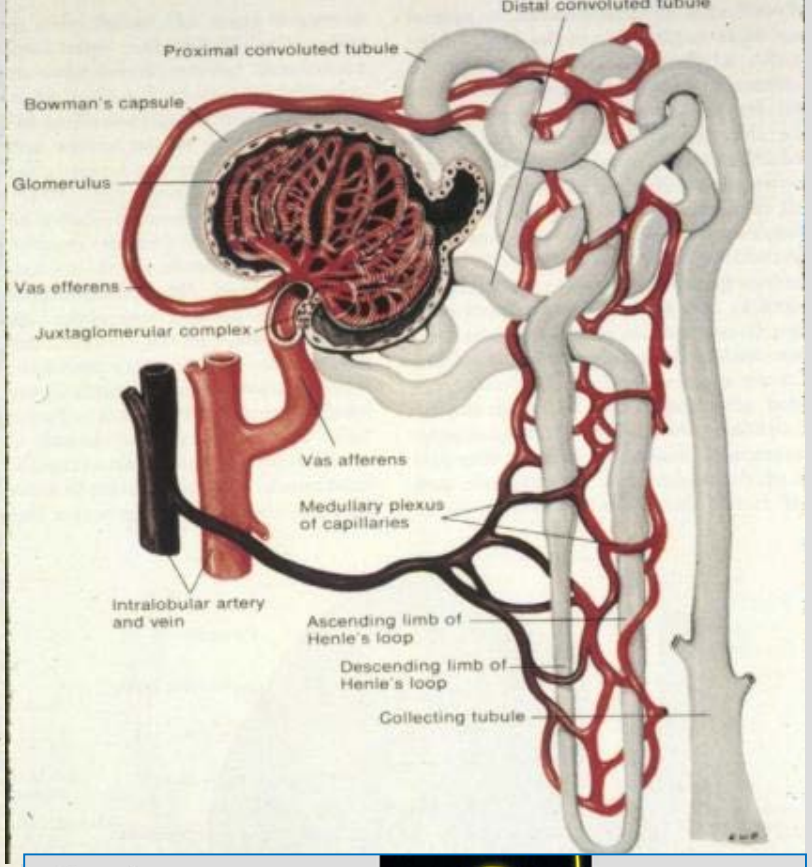


Figure 34–3 The functional nephron.



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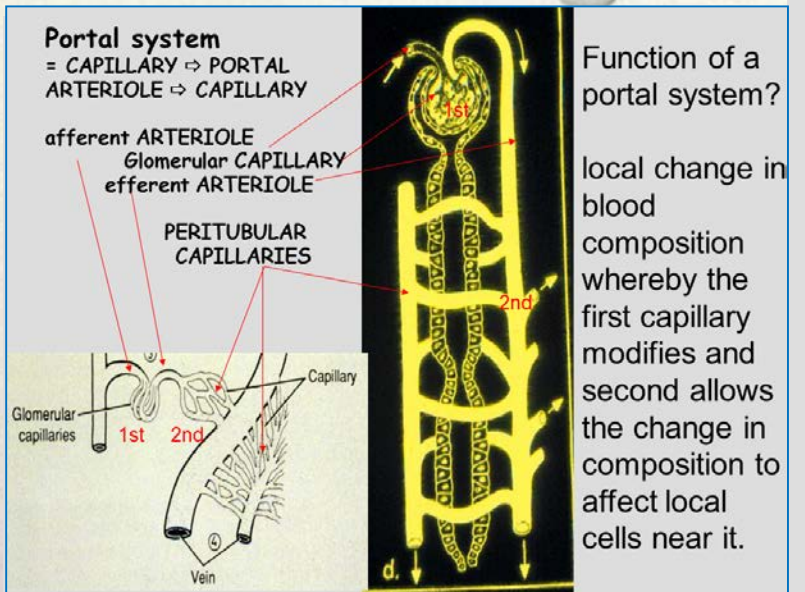

Function of a portal system?

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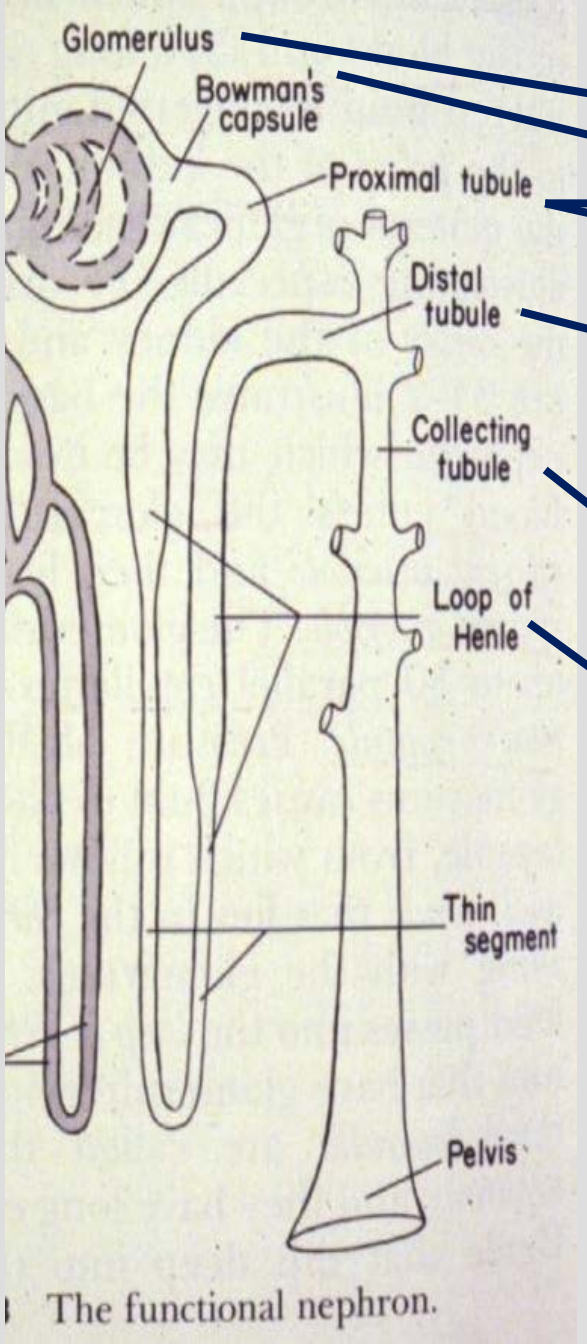
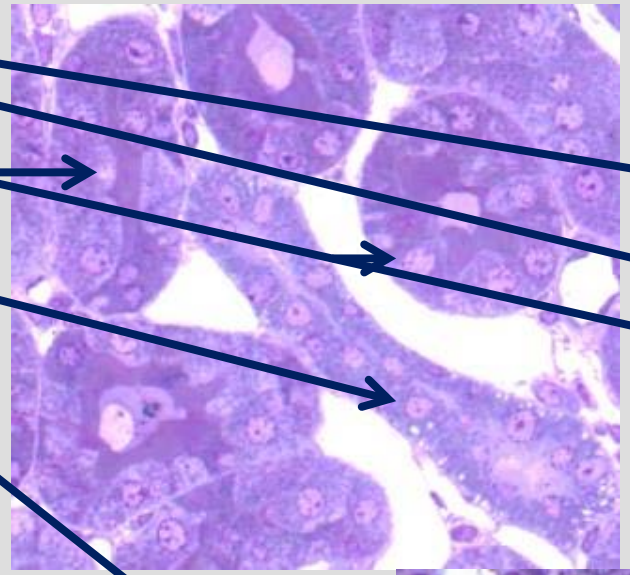
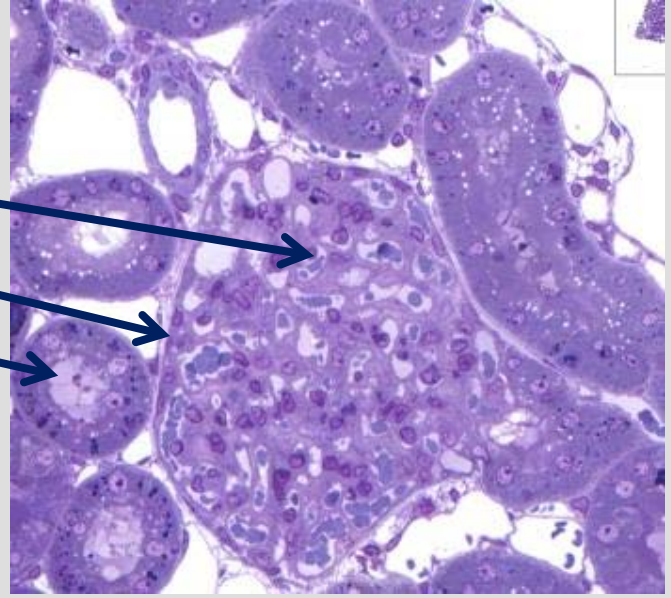
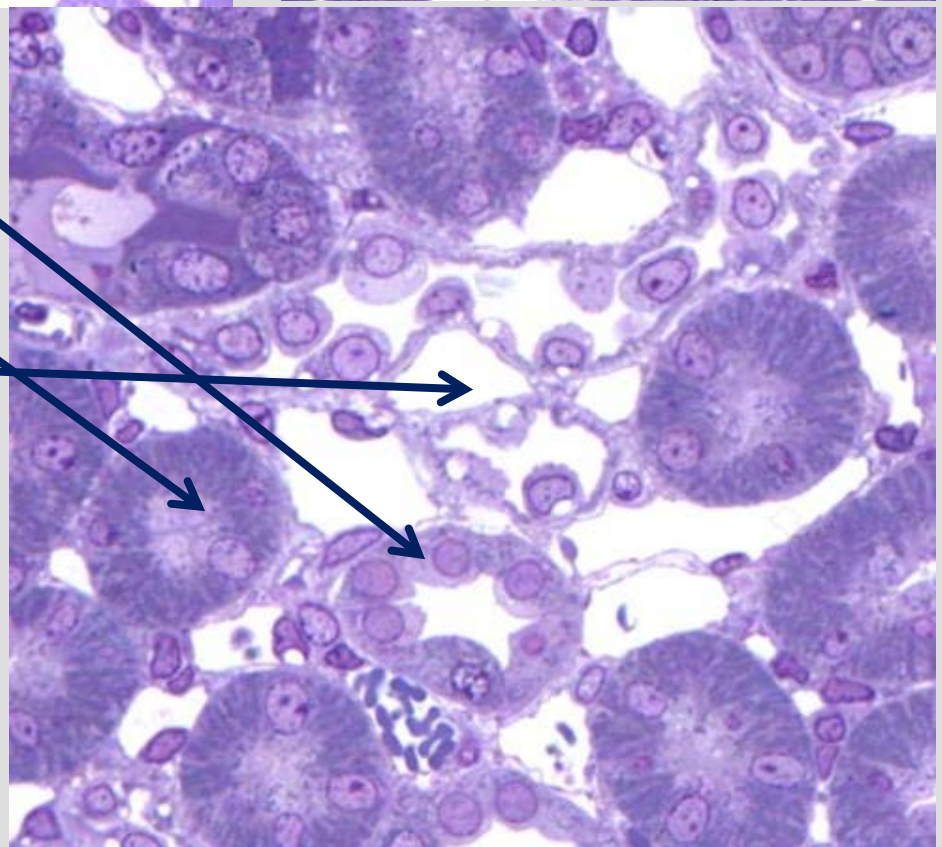


The functional nephron.







Nephrons are the structural and functional units of the kidney.

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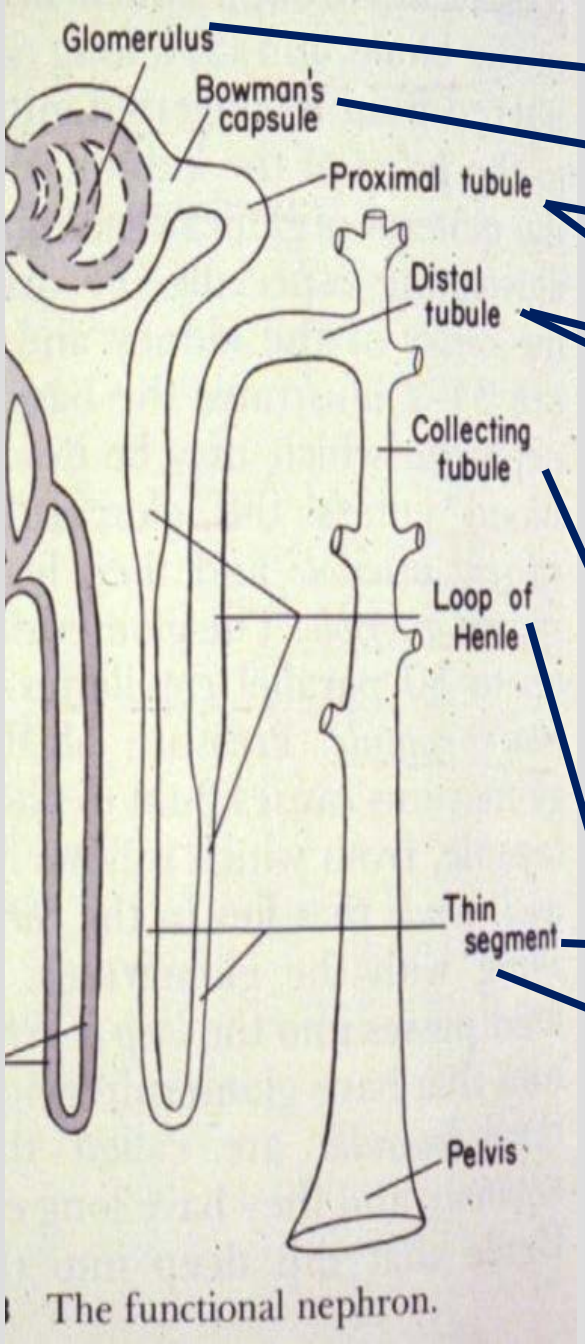
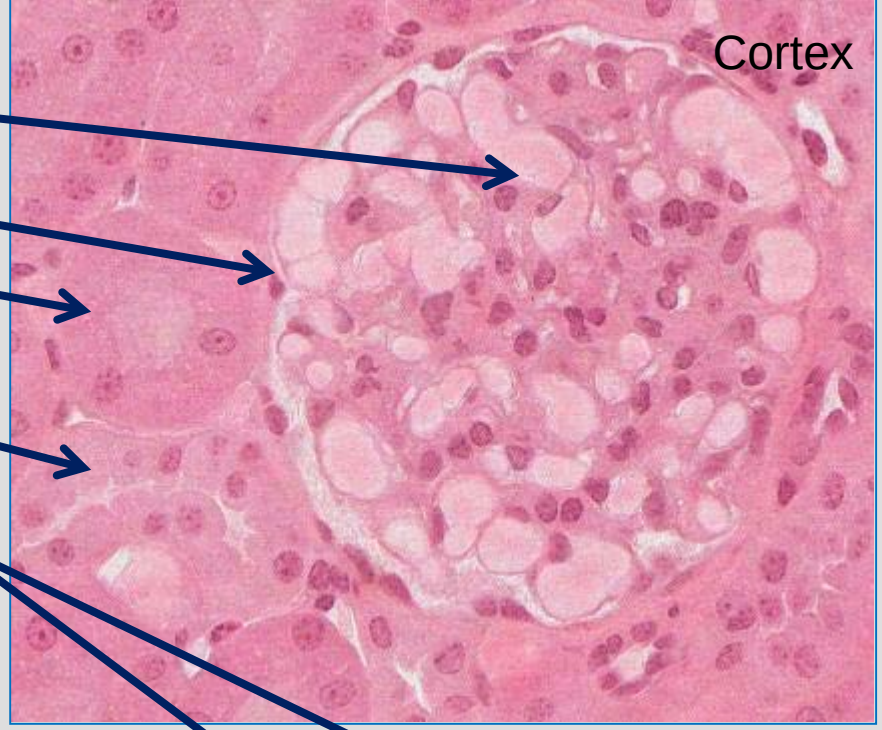
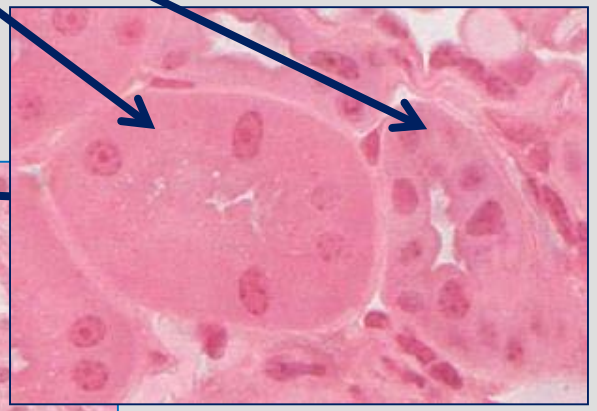
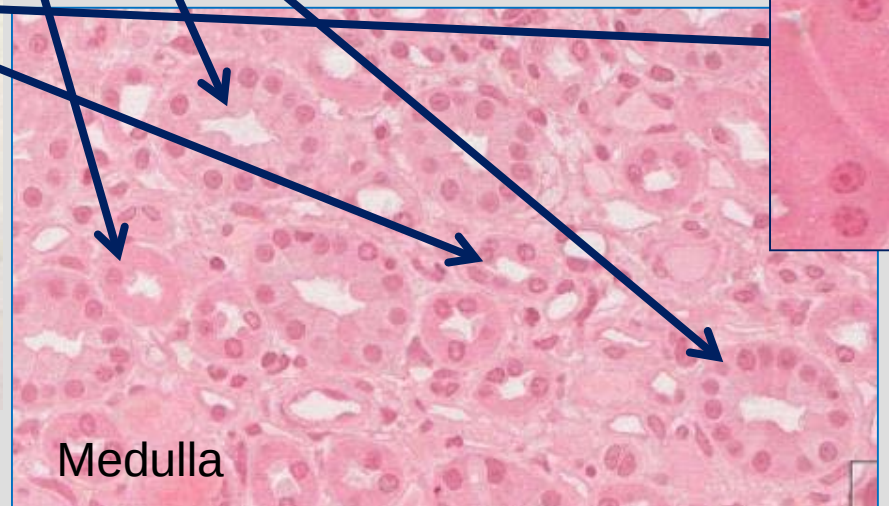


The functional nephron.







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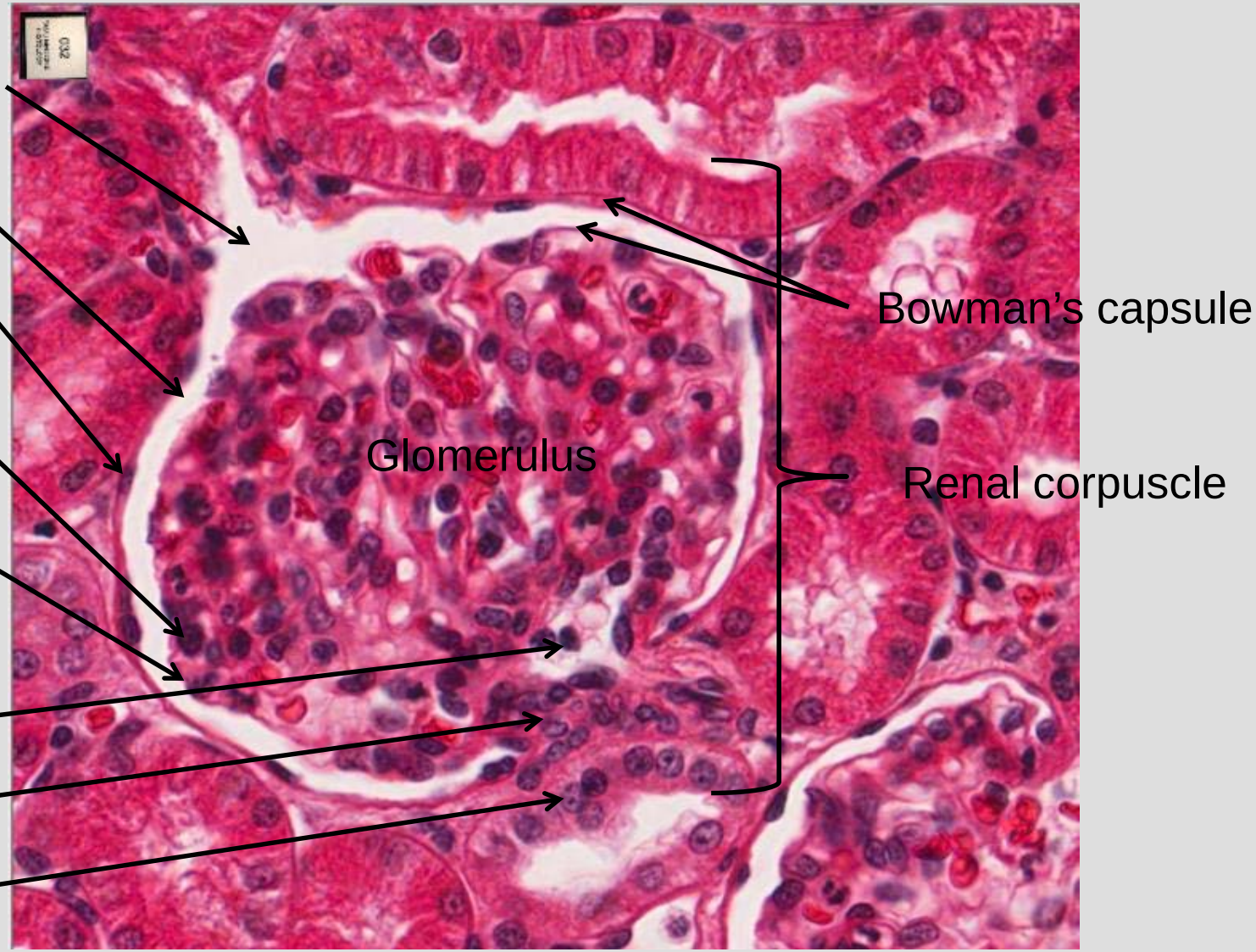
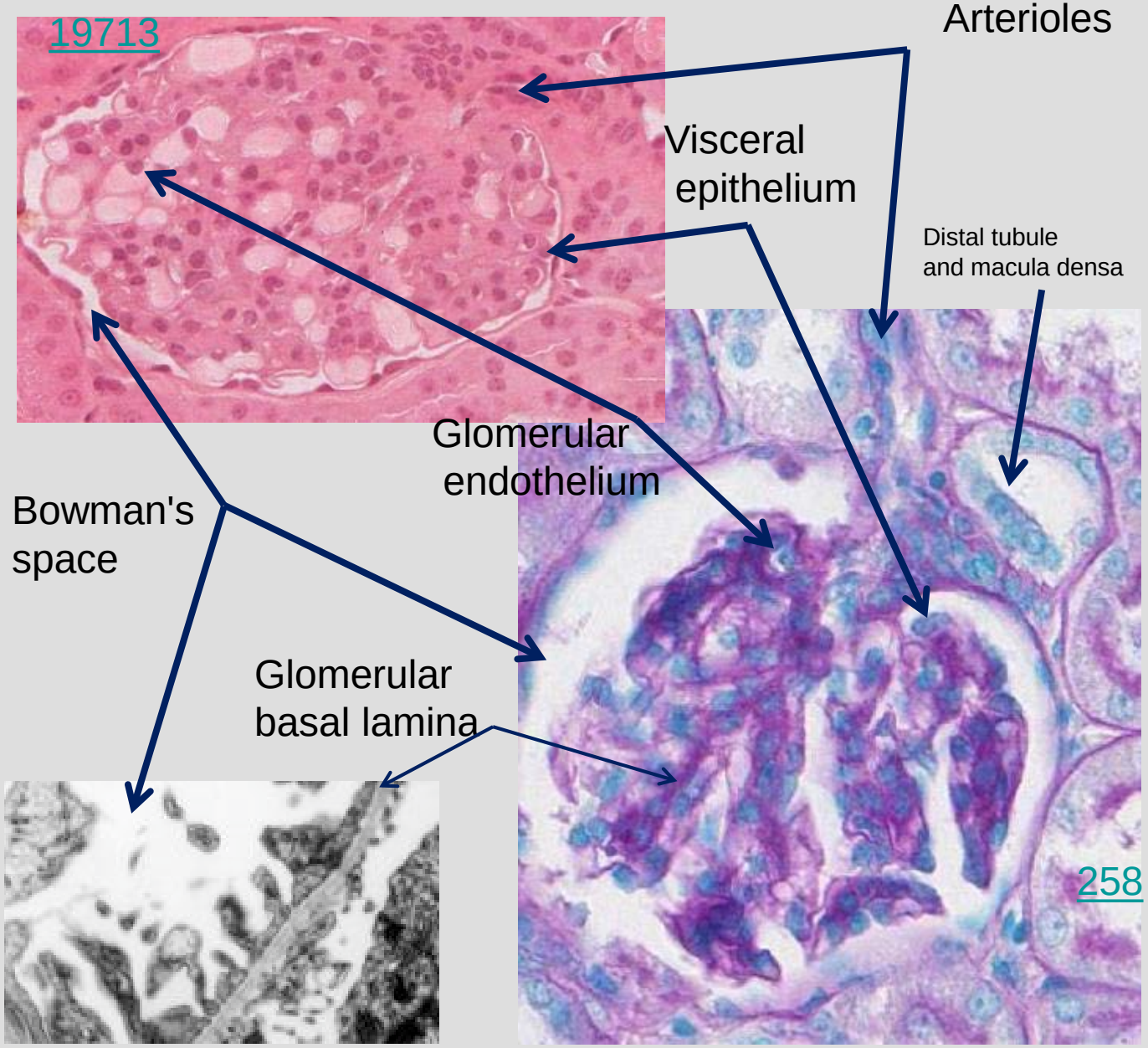
Slide Histo 032: Kidney (H&E)



Renal corpuscle



The renal corpuscle provides the anatomical structure required for the first phase of urine formation: the production of the glomerular filtrate.

Several histological arrangements and structures are required for the production of glomerular filtrate:
1) arterioles entering and leaving the glomerulus,
2) glomerular endothelium,
3) glomerular basal lamina, and
4) visceral epithelium of the Bowman's capsule

Components of the filtration barrier:

1. The fenestrations of the capillary endothelium, which blocks blood cells and platelets
2. The thick, combined basal laminae, or GBM, which restricts large proteins and some organic anions
3. The filtration slit diaphragms between pedicels, which restrict some small proteins and organic anions

EM 18a

The glomerular basal lamina, thick and anionic, filters macromolecules according to their size and electrostatic charge.

Glomerular Features for Extreme Filtration

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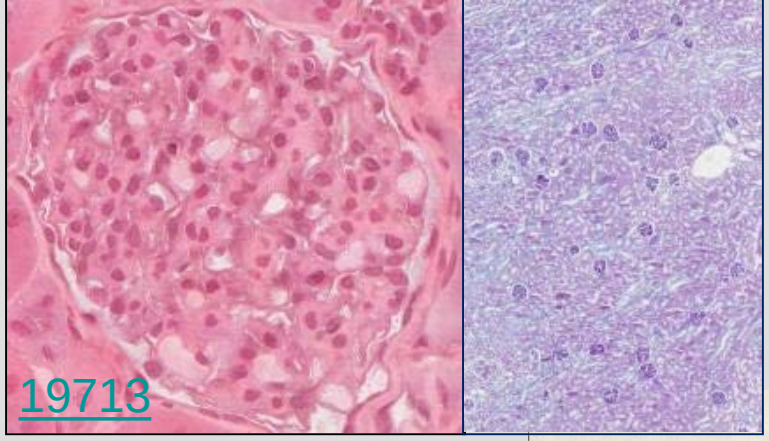

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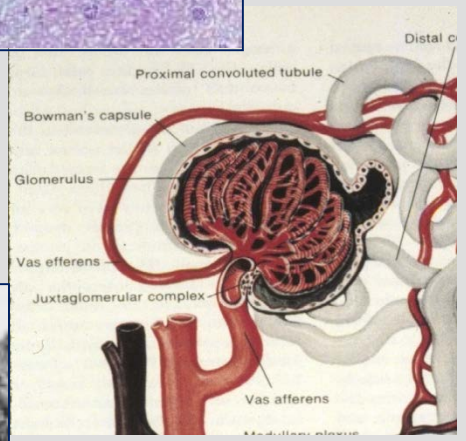
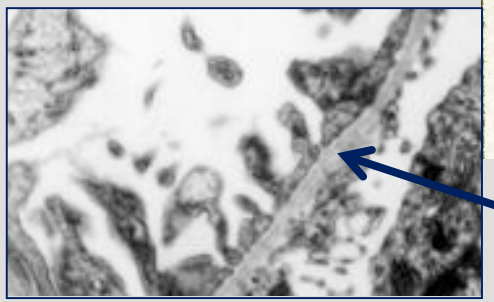


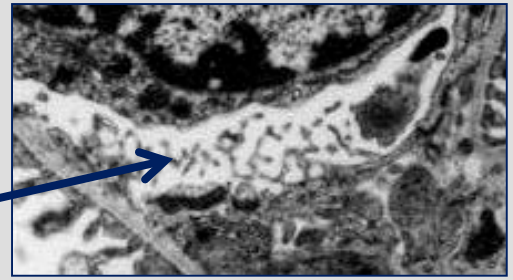
- Very Large Surface Area (1.5 m^2)
- Large resistance afforded by reduced diameter of the efferent arteriole
- Thin Filter (0.1 µm)
- Thus, 25 times more permeable than regular capillaries



Glomerular basal lamina

The hydrostatic pressure within the glomerular capillaries provides the driving force for producing 180 liters of glomerular filtrate per day. The filtrate resembles blood plasma without large (>40,000 MW) proteins.

Endothelium of the glomerular capillaries is fenestrated



Ref code # 5

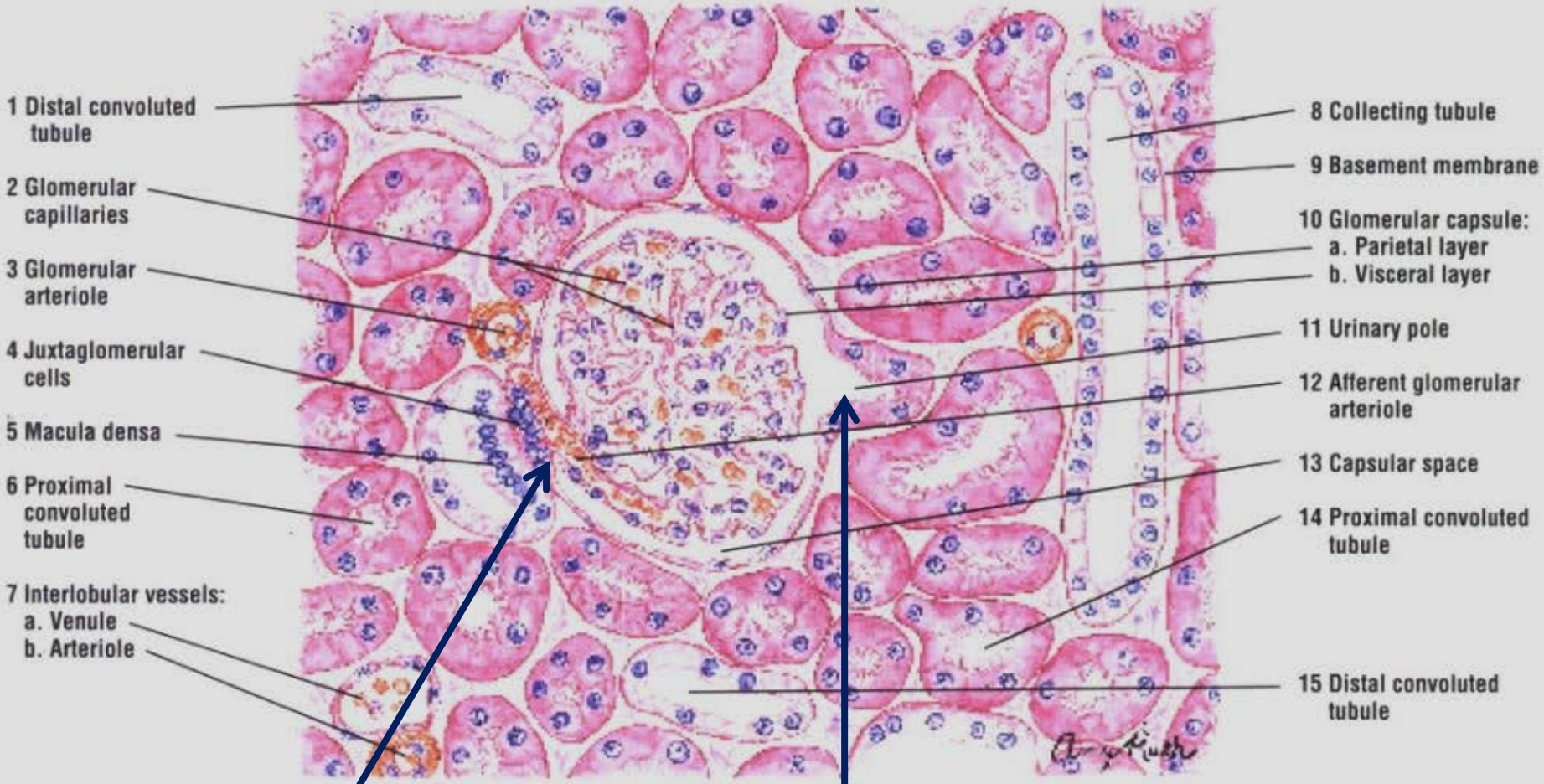
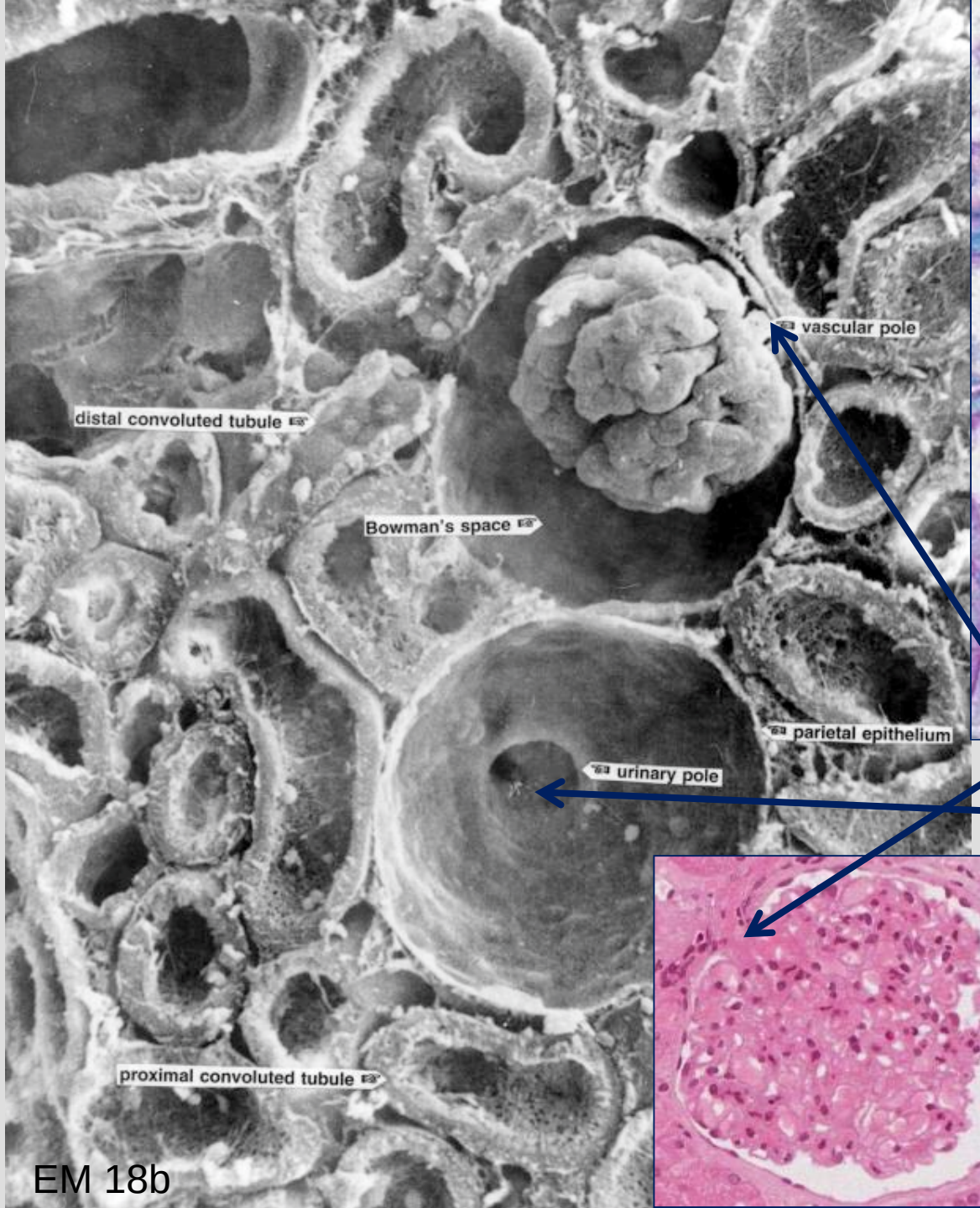


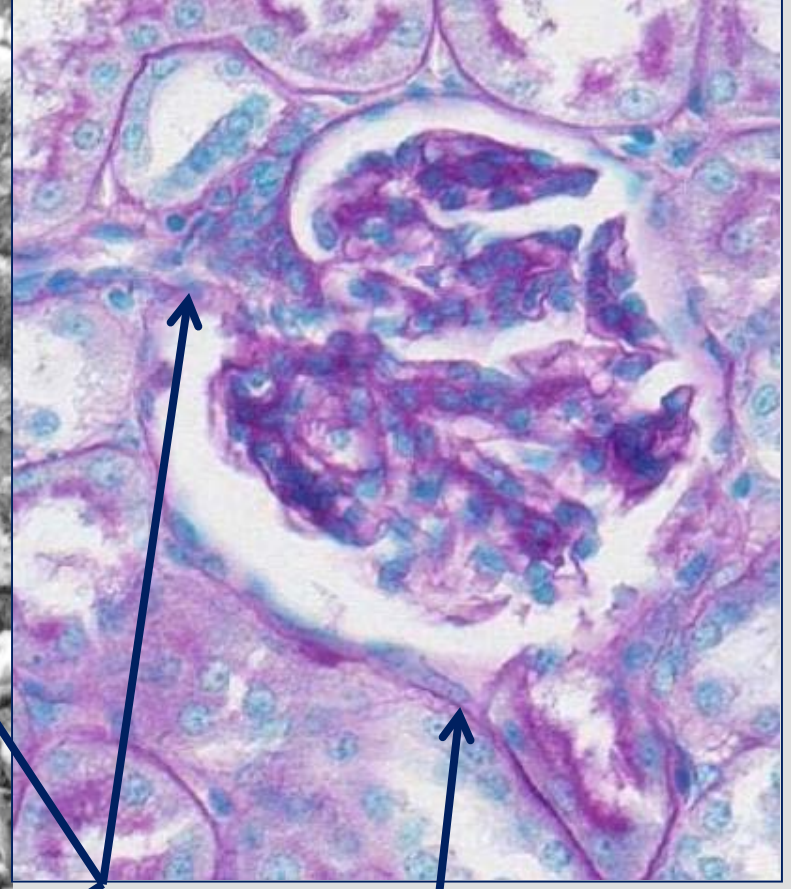
Fig. 15-3 Kidney Cortex: Juxtaglomerular Apparatus. Stain: periodic acid-Schiff and hematoxylin. Medium magnification.

Vascular pole – site of afferent and efferent arterioles

Urinary pole – site of union of parietal cells of Bowman's Capsule and cells lining the proximal convoluted tubules



EM 18b

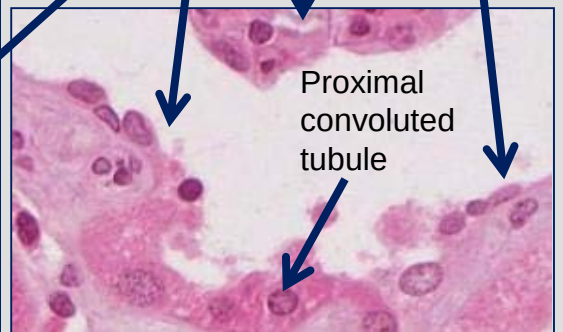


Vascular pole

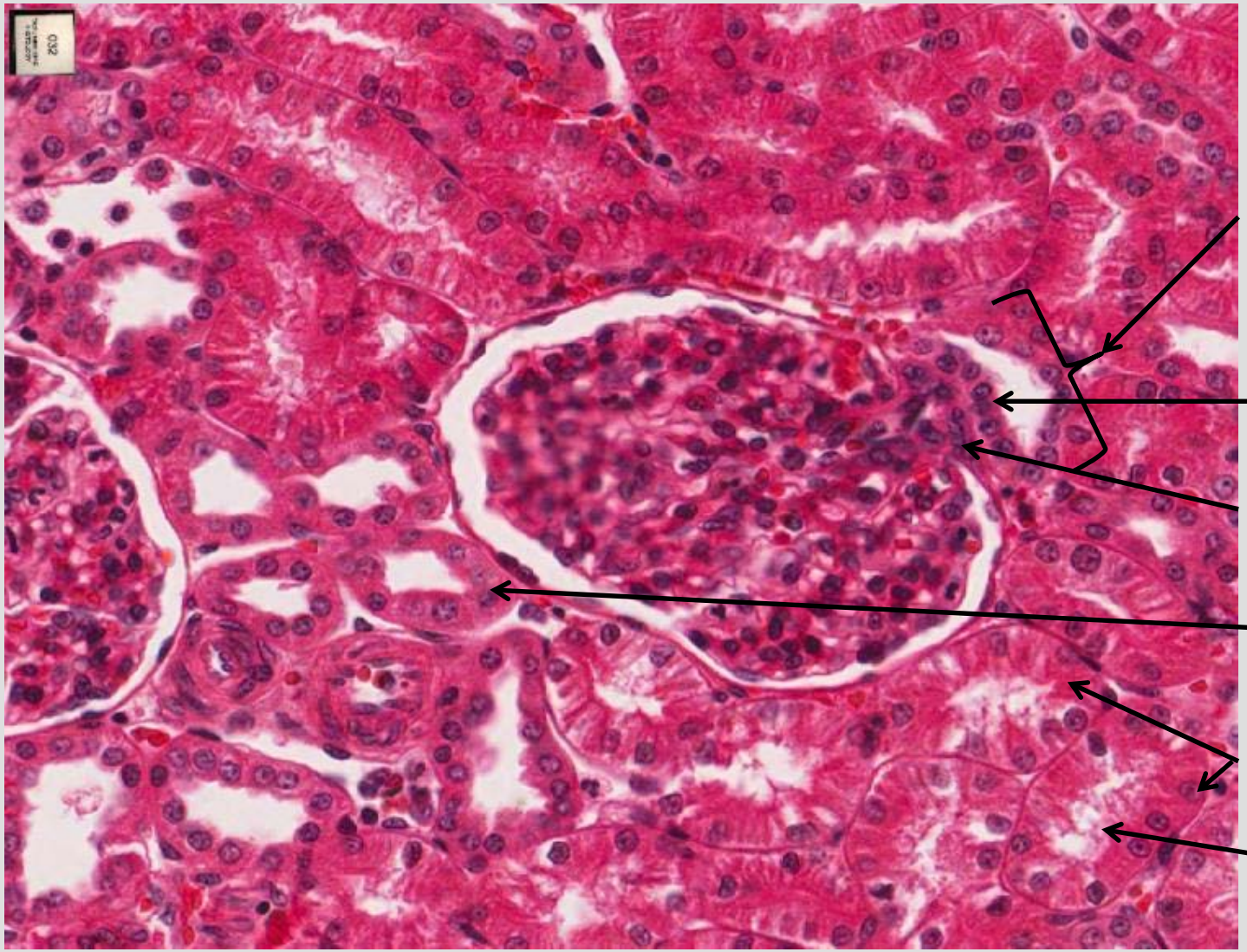
258

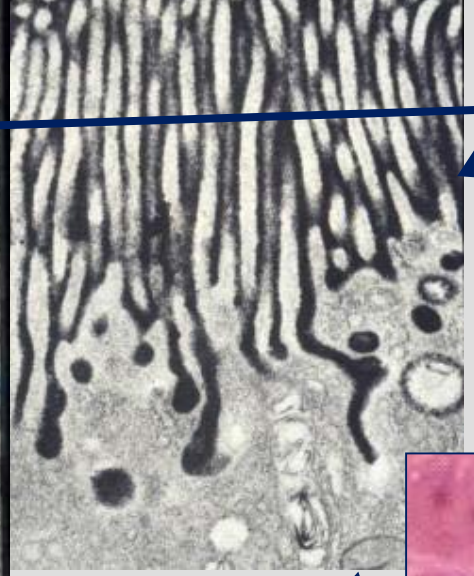
Urinary pole

19713



Slide Histo 032: Kidney (H&E)



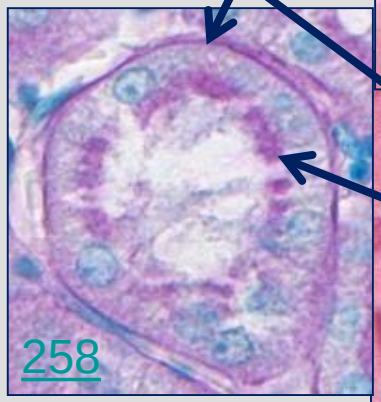


Brush border is involved in reabsorption of protein.

Ref code # 6, 19

19713

Proximal convoluted tubules



258

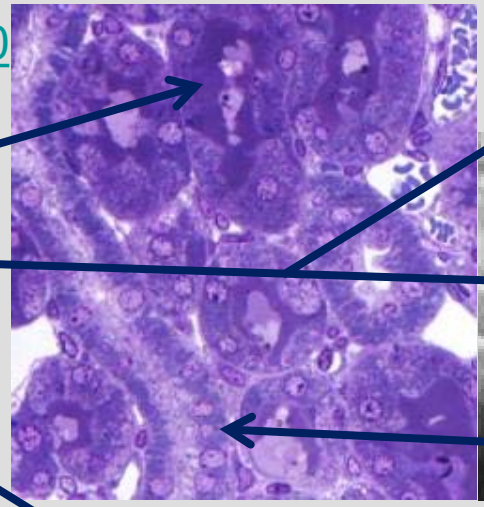
Brush border

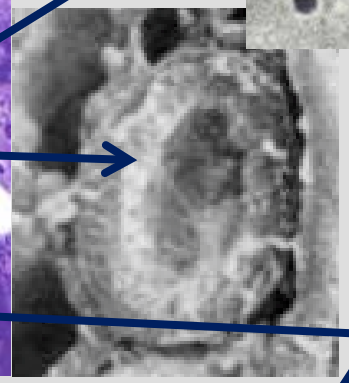
0 to 8 mg/dL protein in urine is considered normal.

Proximal Convoluted Tubules

Ref code
6, 19

34400



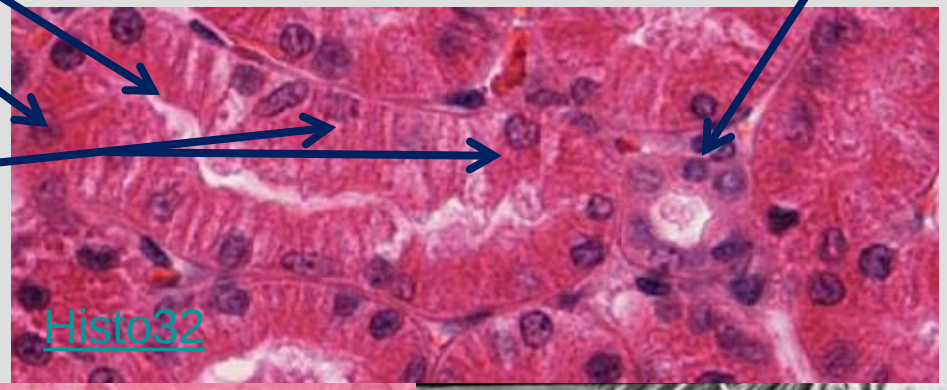


Distal tubules

Brush border

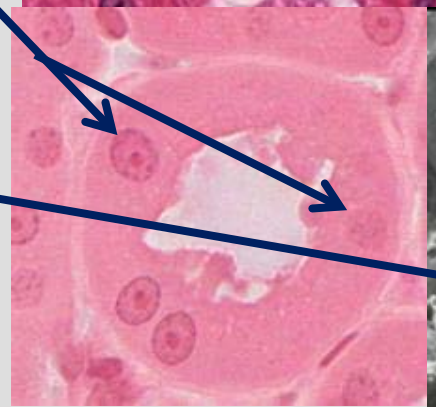
Acidophilic cytoplasm

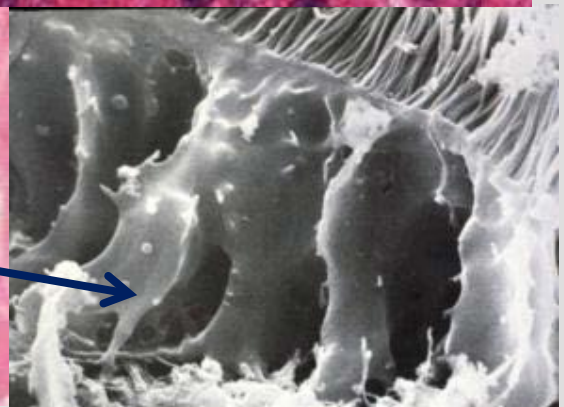
Nuclei far apart



Histo32

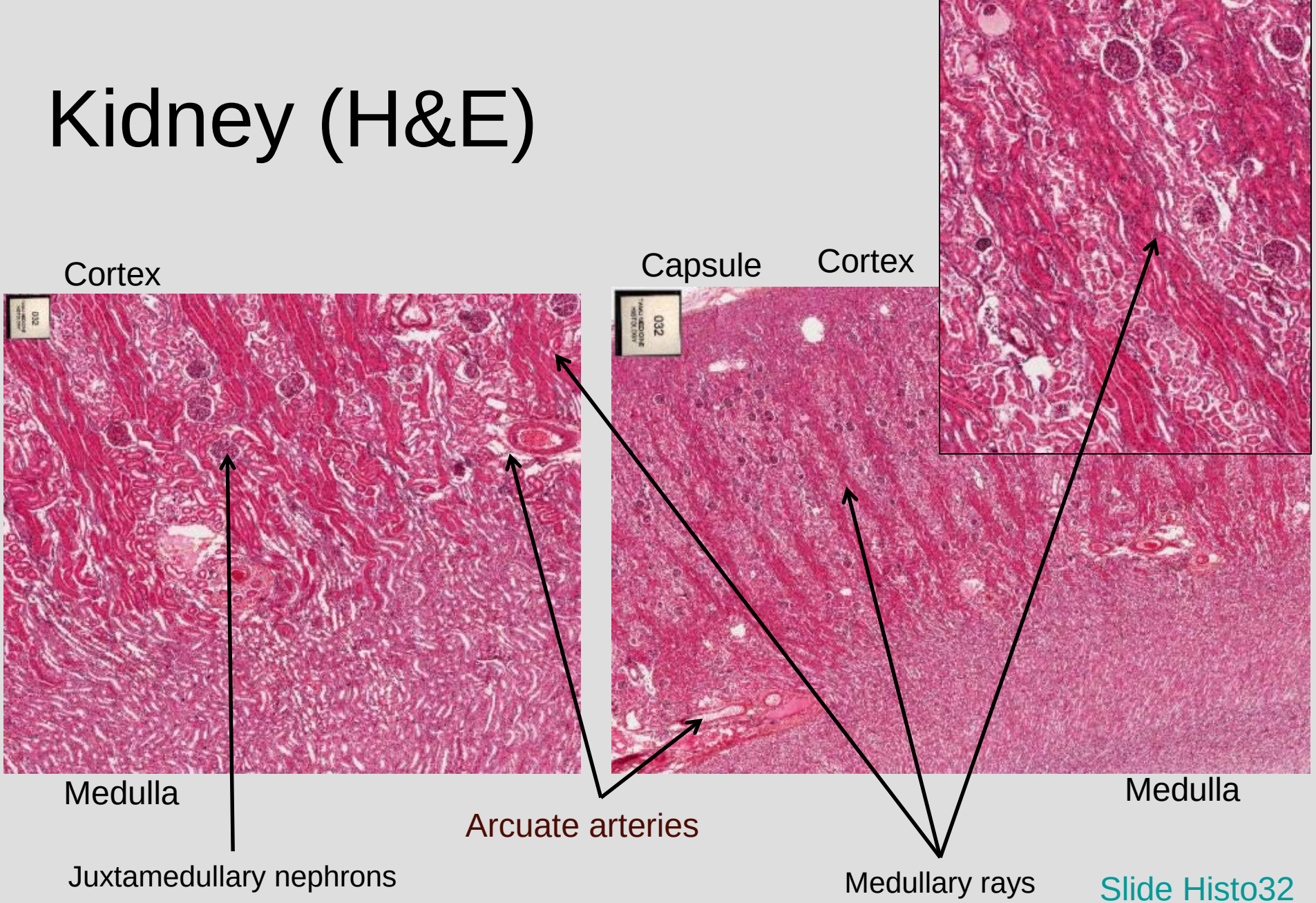
Indistinct lateral cell boundaries



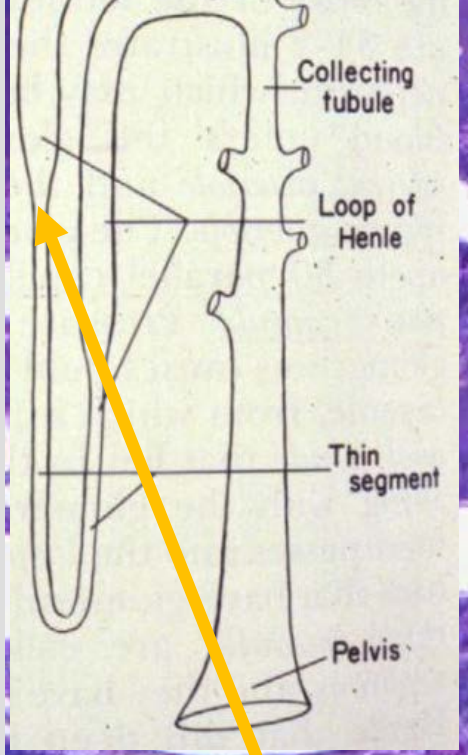


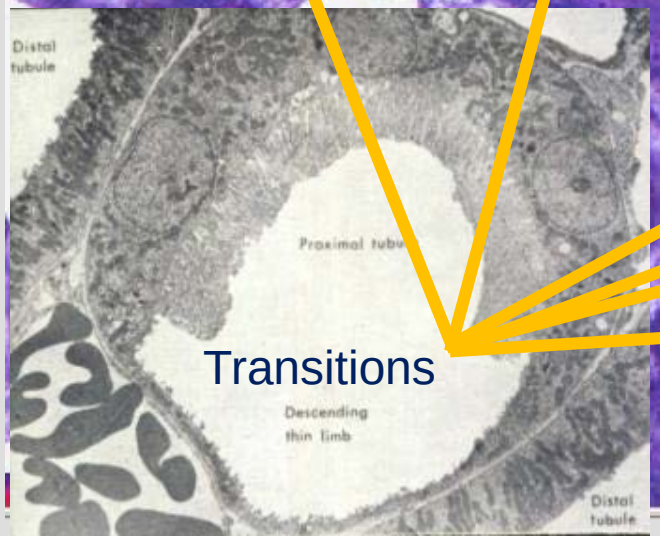
19713

Kidney (H&E)



Slide Histo32

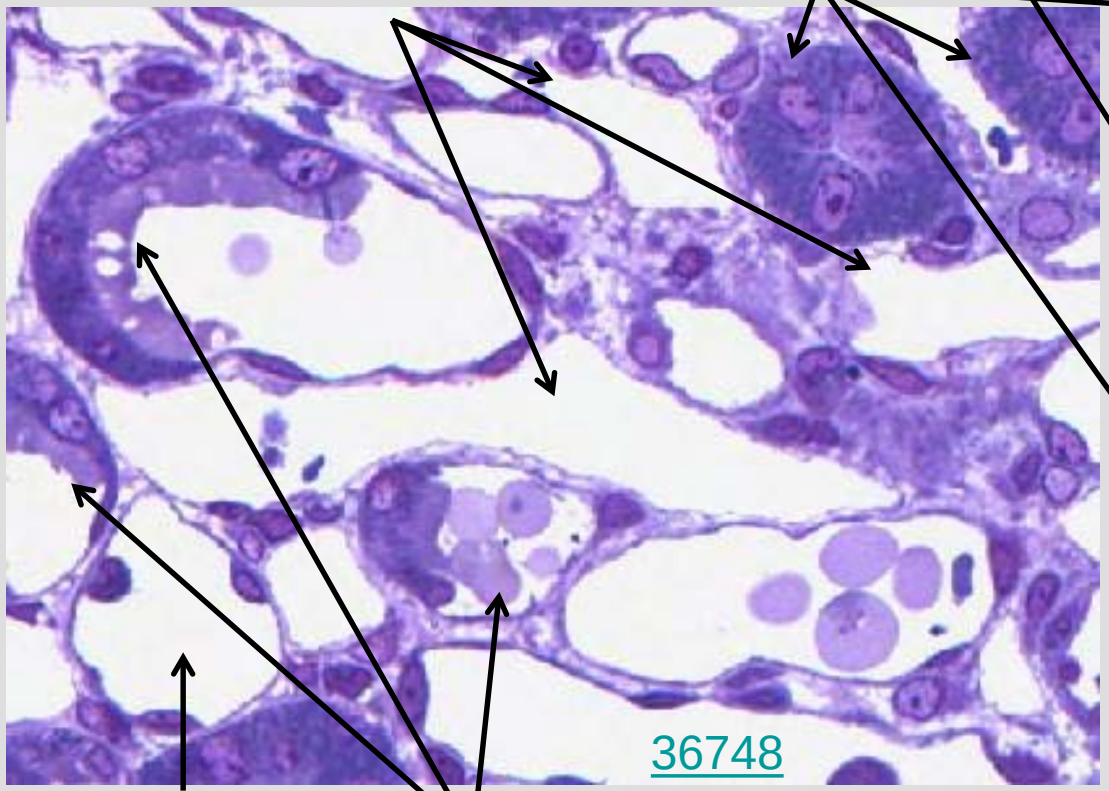


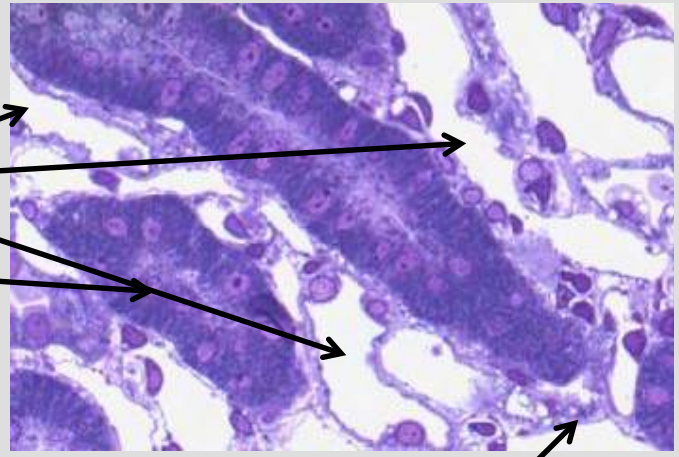


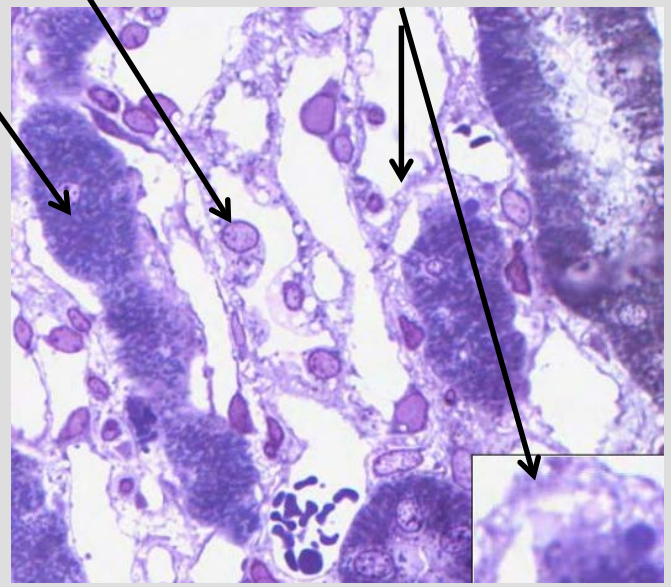
Transitions

Ref code # 8

Toulidine blue kidney







Ascending loop of Henle

Peritubular capillaries of the vasa recta

Distal tubules

Transition from ascending loop of Henle to distal tubules

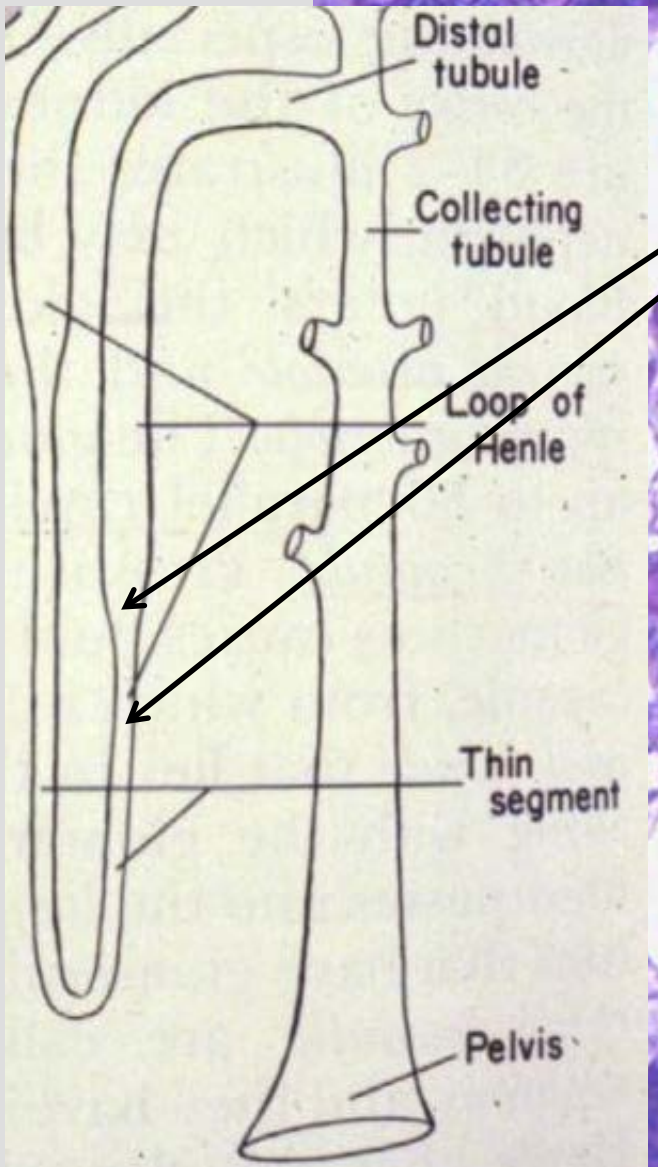
Descending loop of Henle

Transition from proximal tubules to thin descending loop of Henle

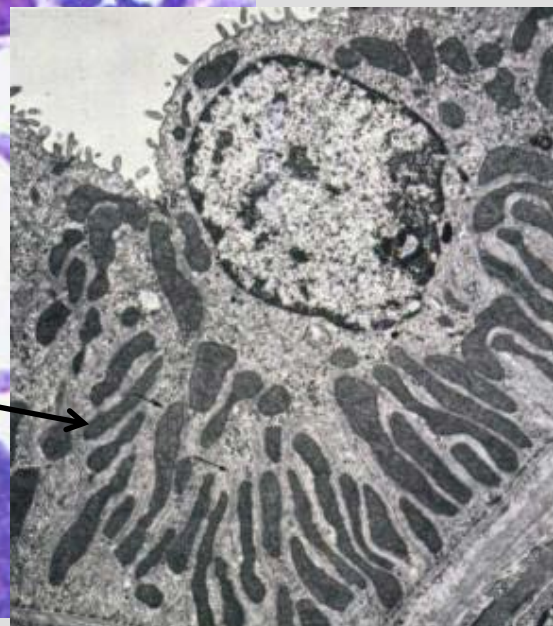
Transitions from ascending loop of Henle to distal tubules

36748

Ref code # 6, 8



Enfolding of the basal cell membrane line up mitochondria in cells of the distal tubule.



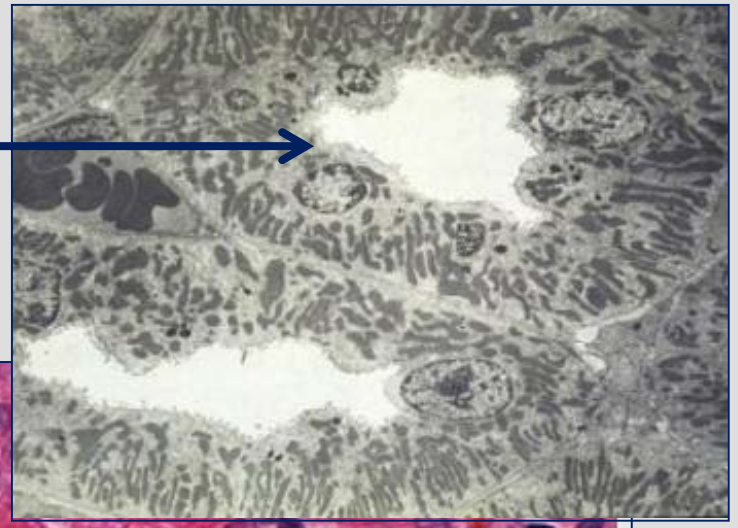
Distal Convoluted Tubules

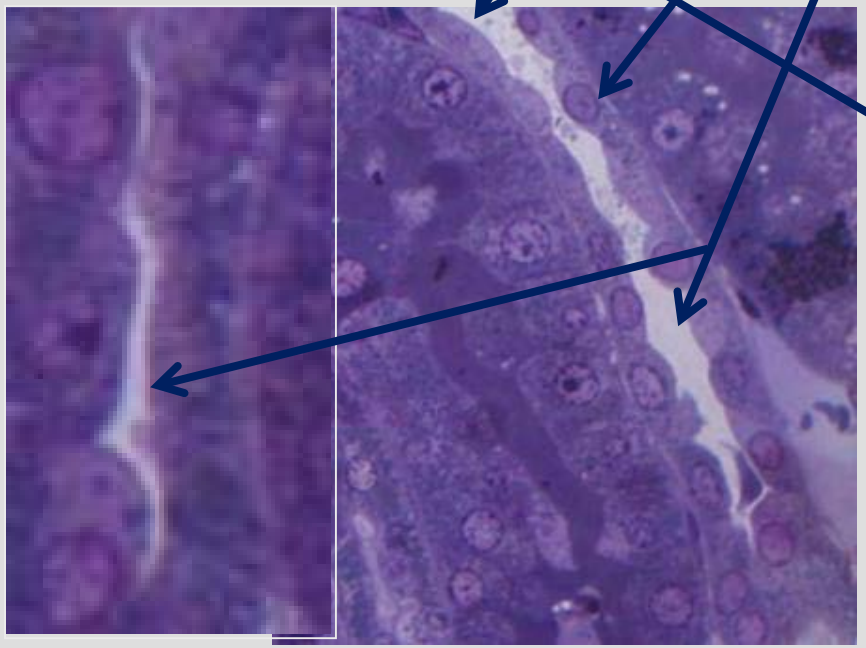
No brush border

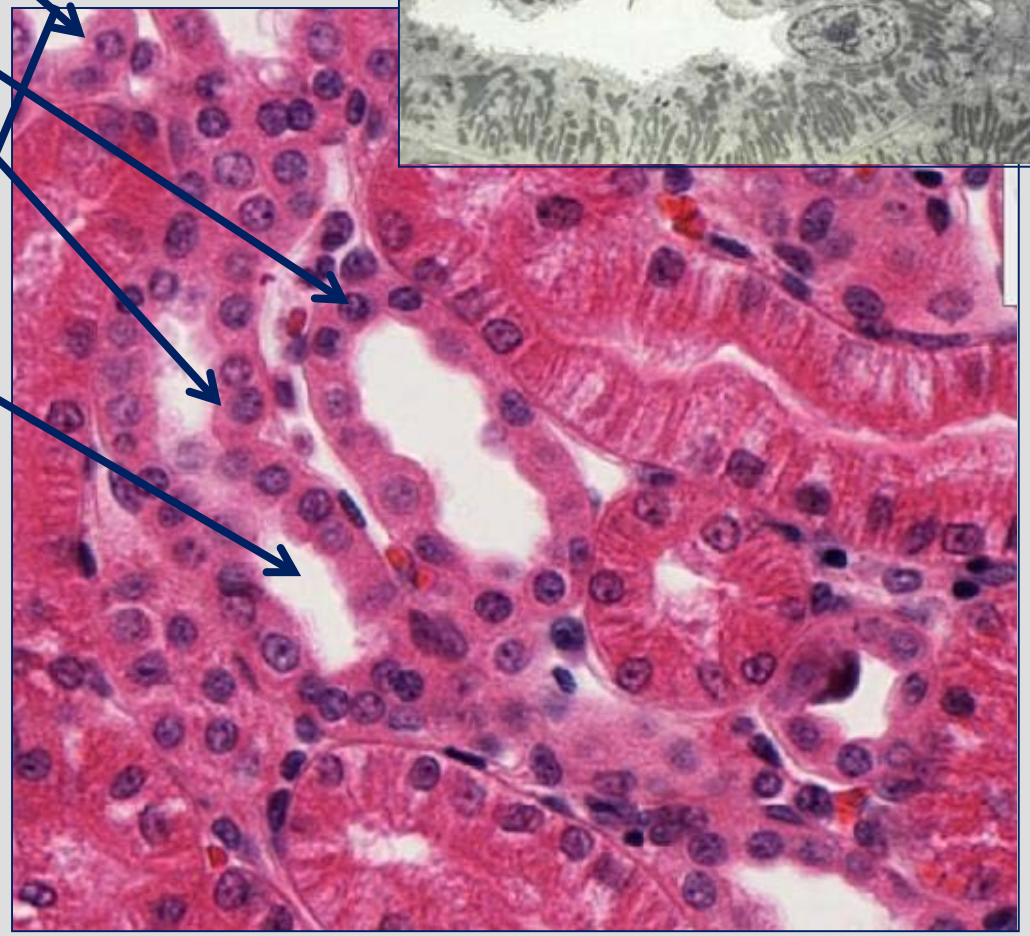
Less acidophilic cytoplasm

Nuclei relatively close

Larger lumen

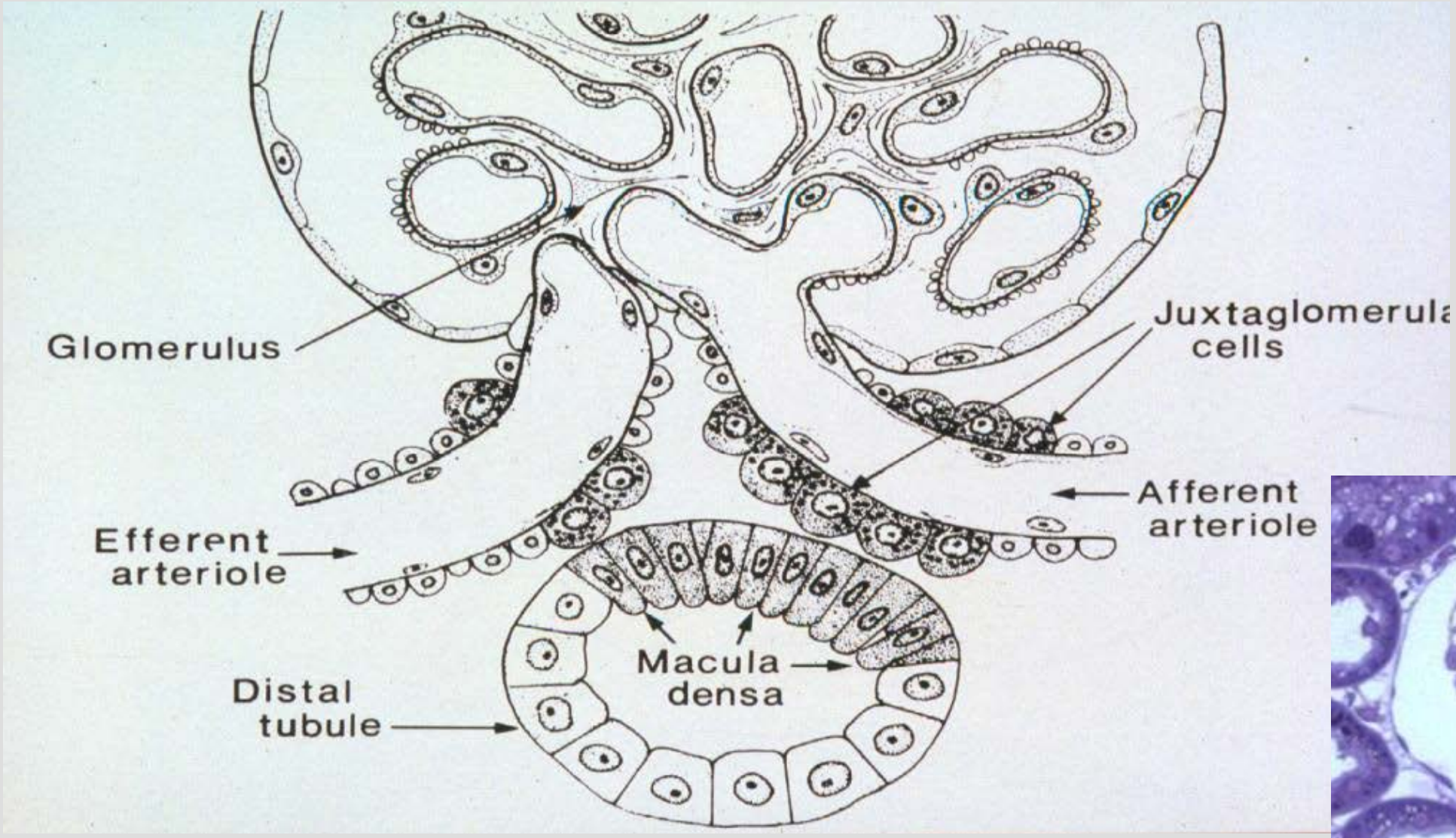


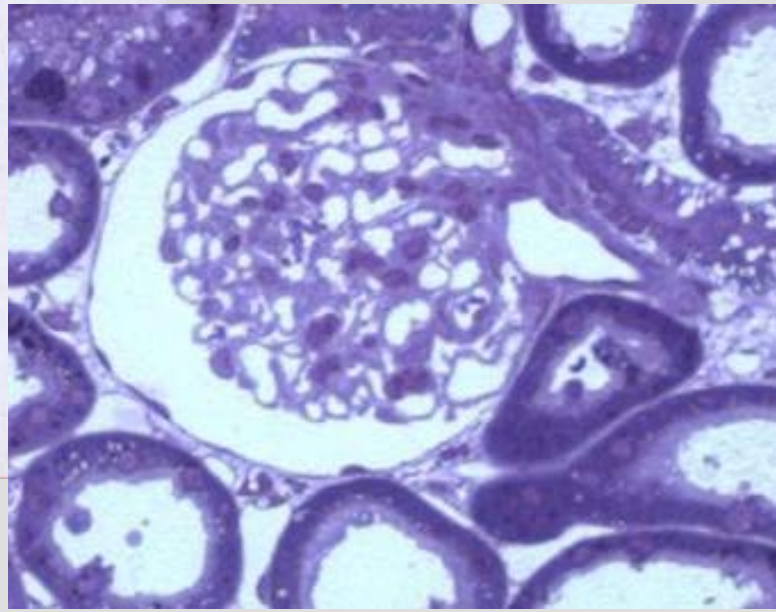




Juxtaglomerular apparatus

Ref code
7

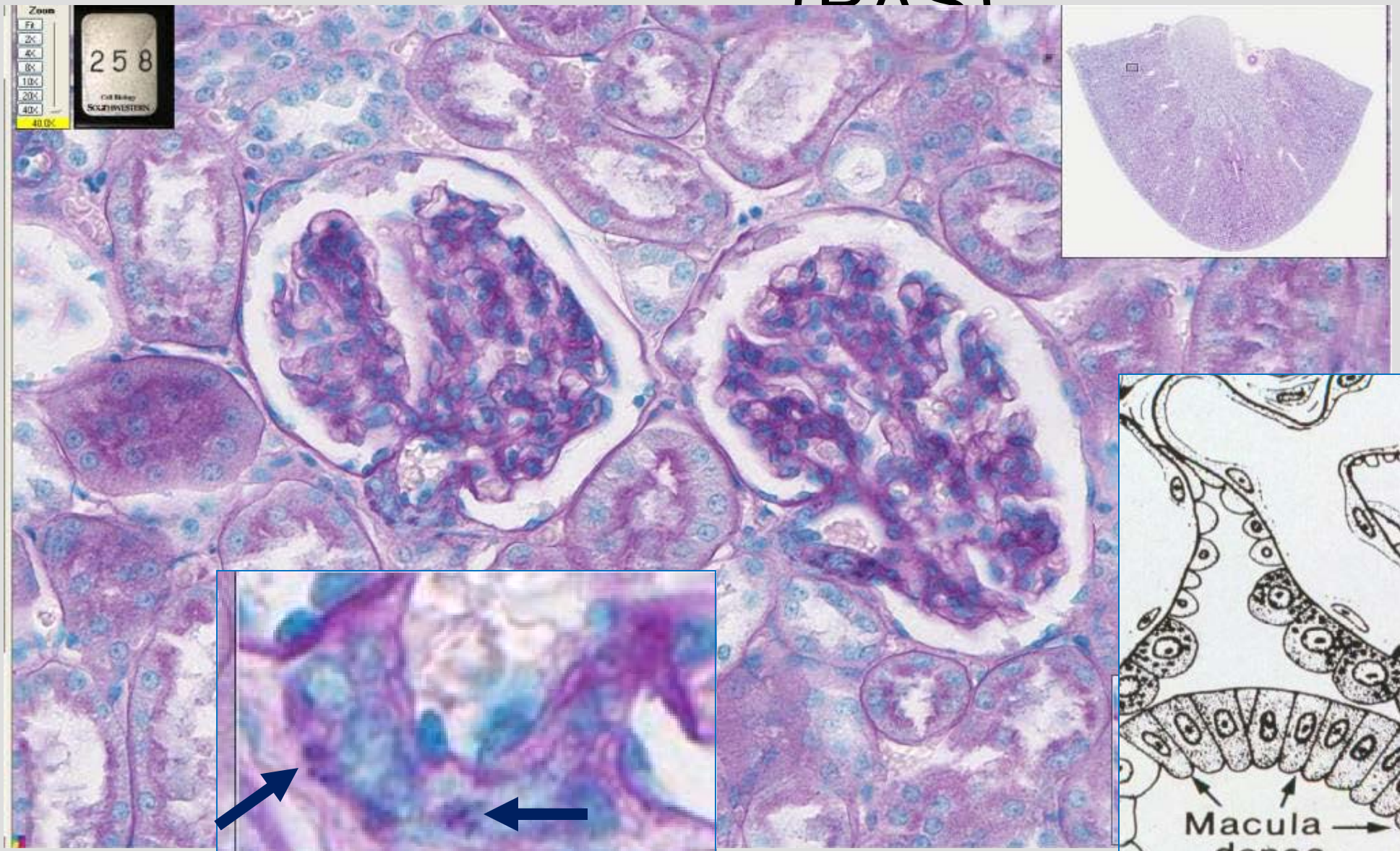


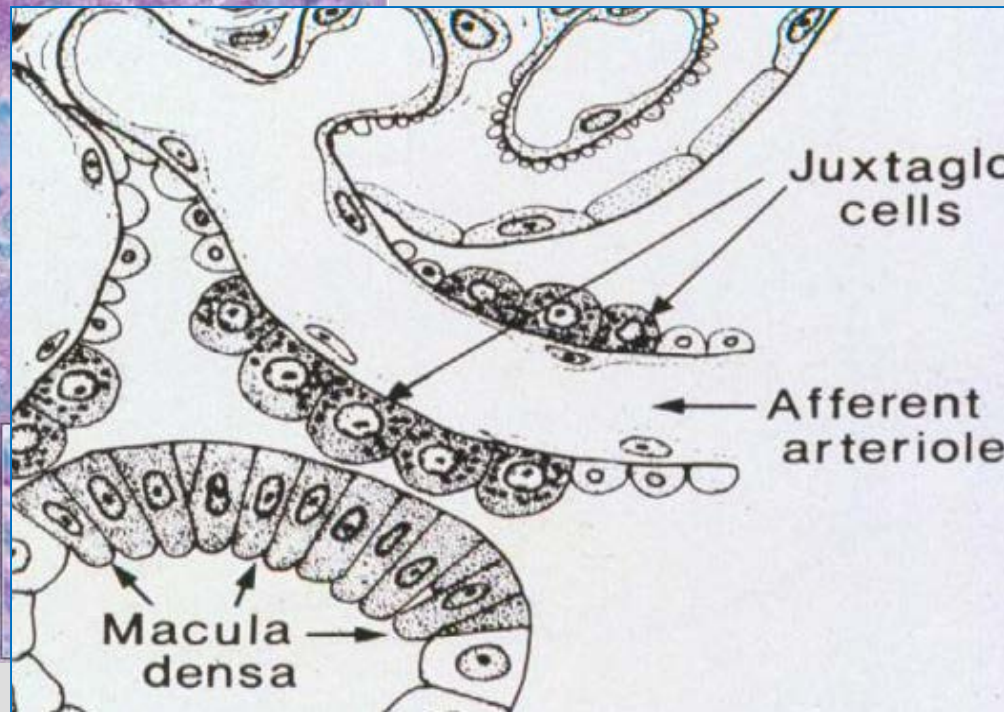


258

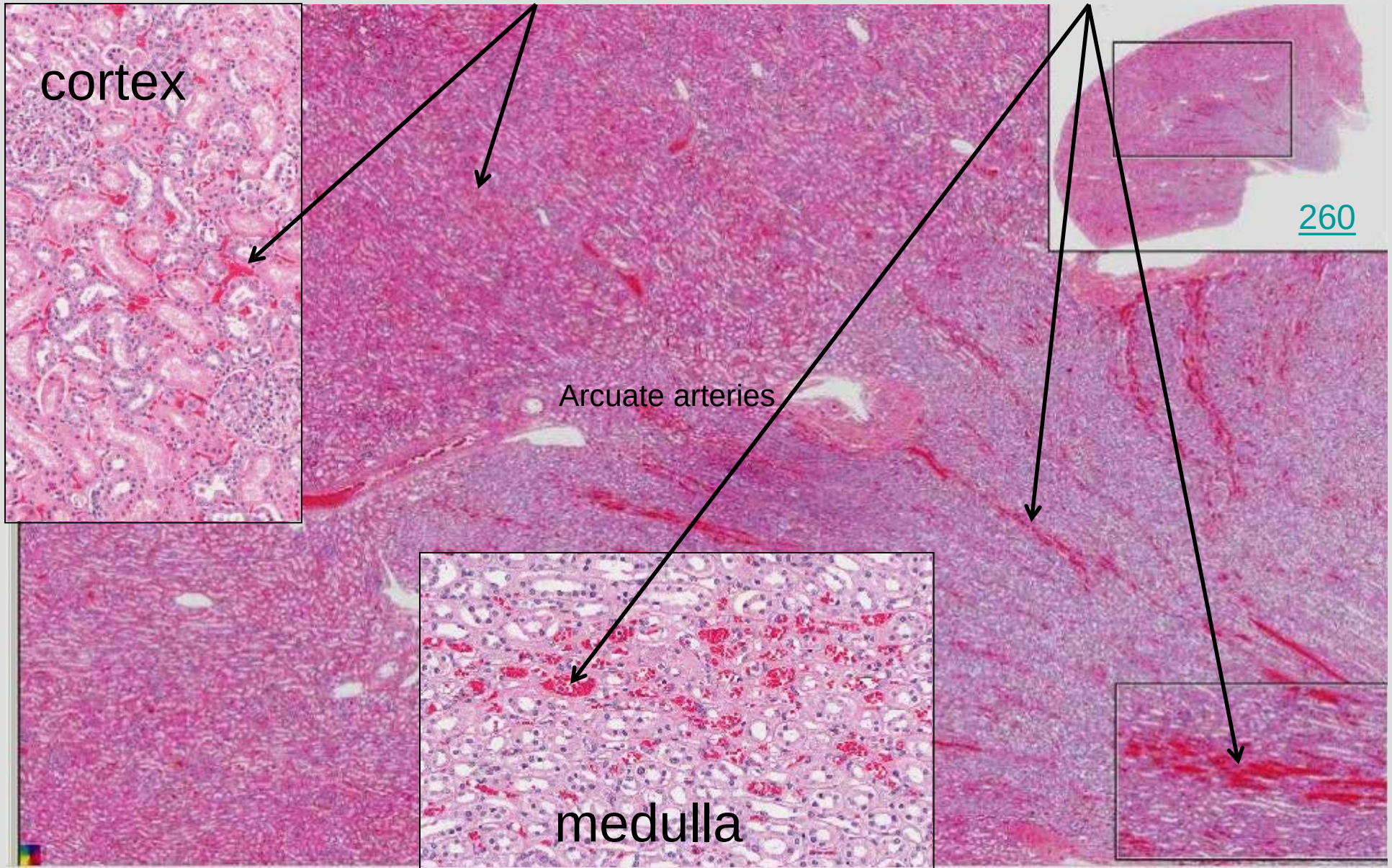
Renin granules in JG cells of Kidney (PAS)

Ref code # 7





Rich blood supply of peritubular capillaries and vasa recta

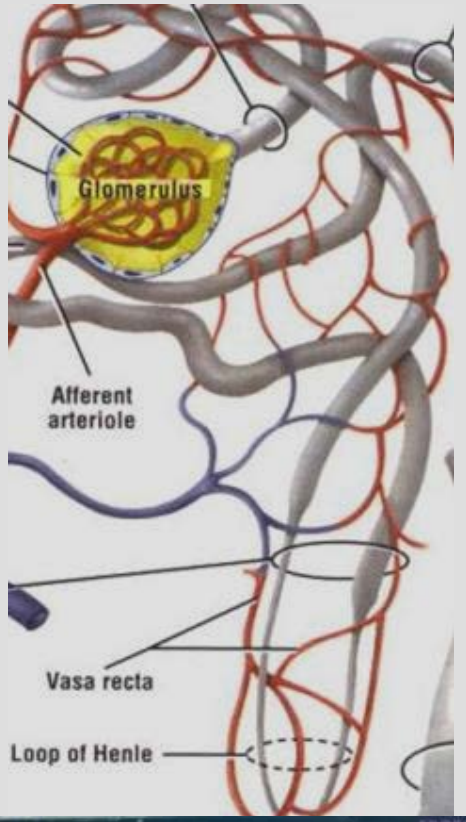


Ref code
5

36748

Ascending
loop of Henle

Distal tubule



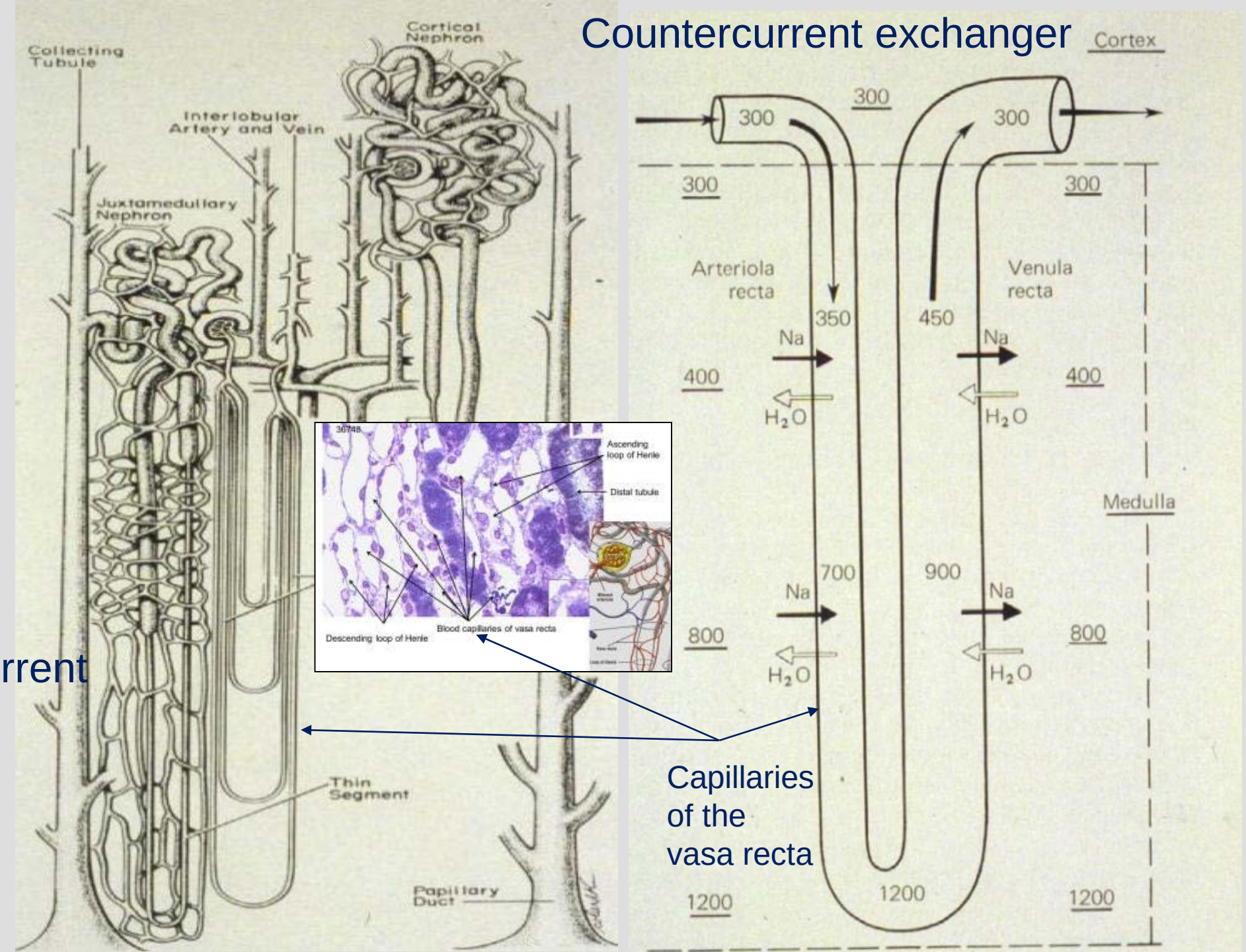
Blood capillaries of the vasa recta

Descending loop of Henle

di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS

Countercurrent exchanger

Ref code
5, 6



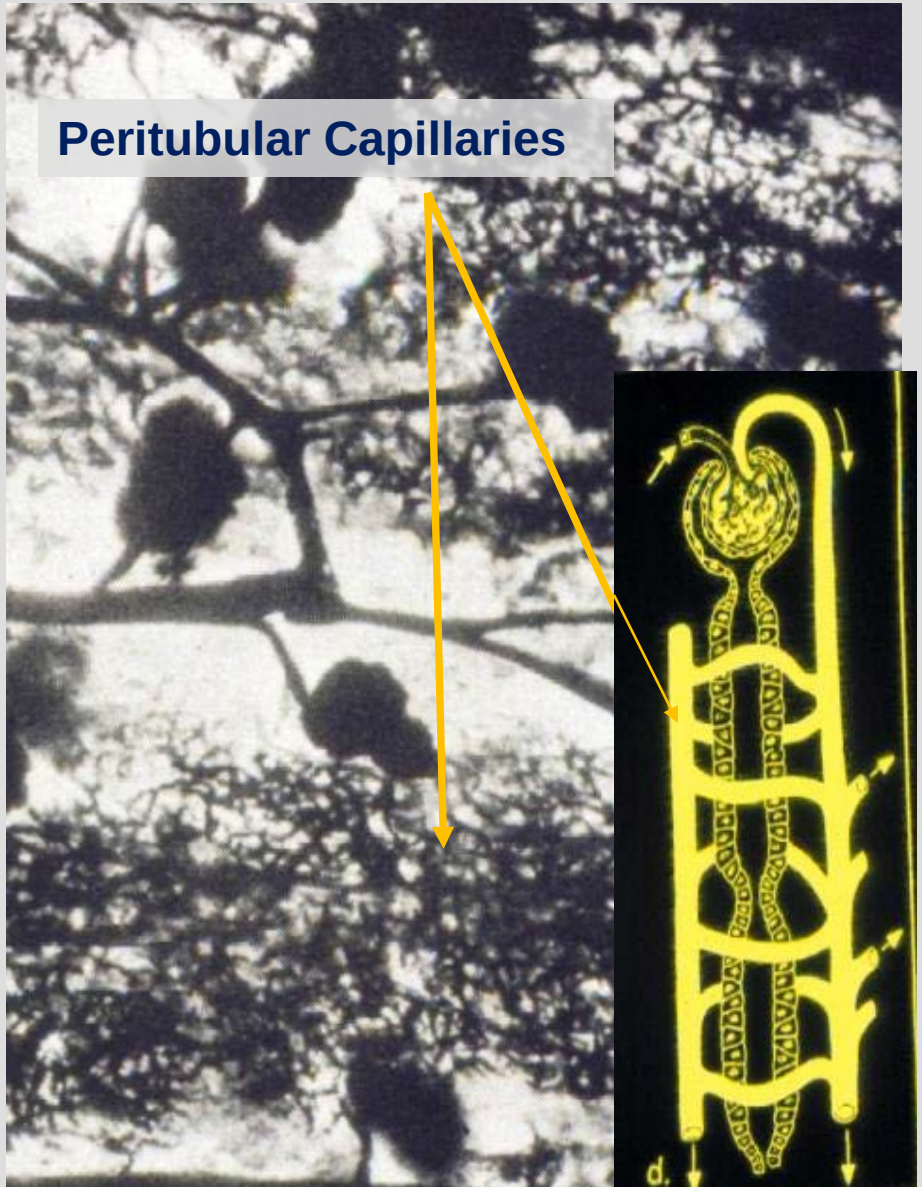
Countercurrent multiplier

Capillaries of the vasa recta

Peritubular Capillaries

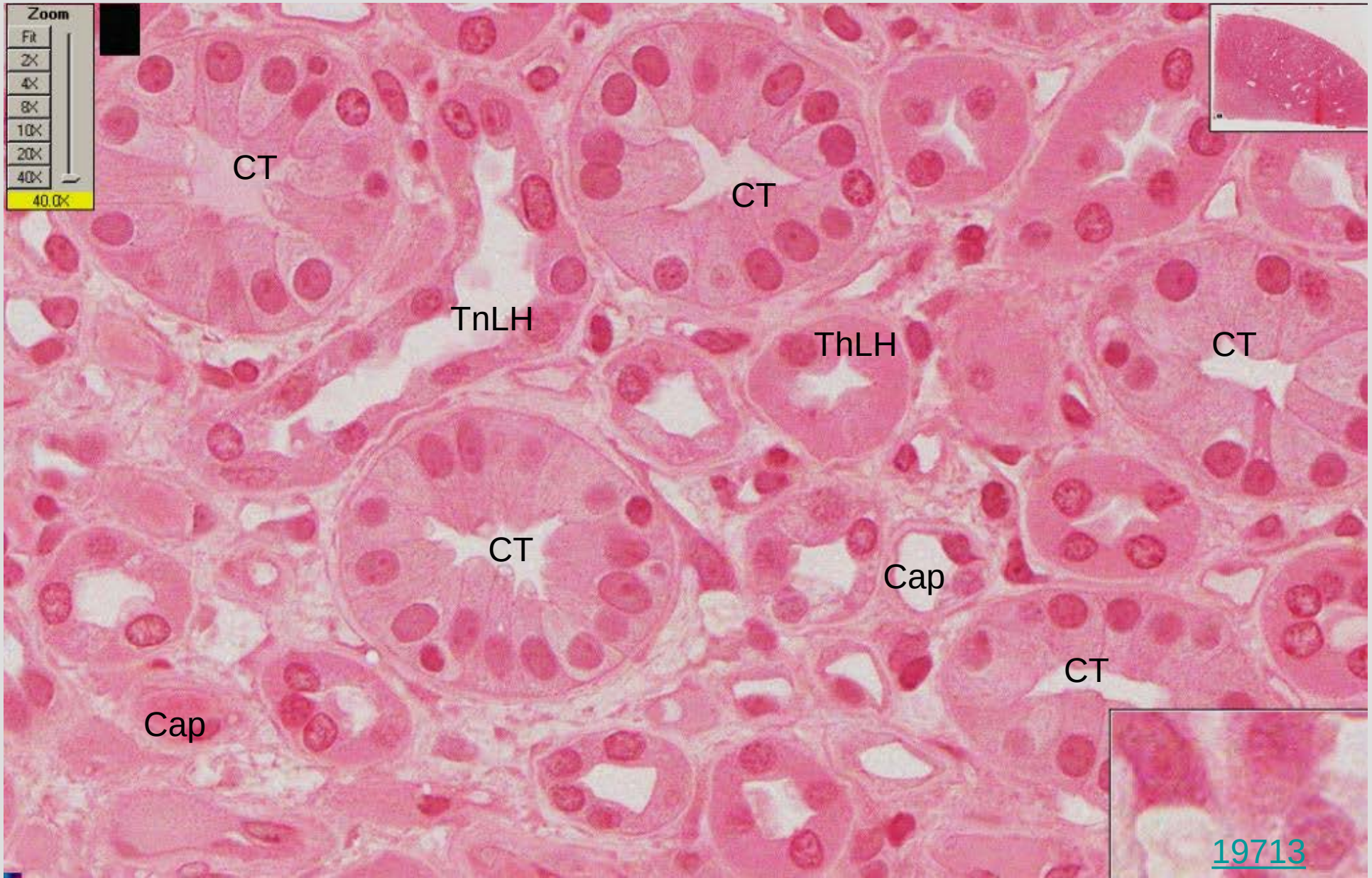
- Absorbs - 180 liters/day from interstitial spaces; thus, ~4 times reabsorption of venous end of all other capillaries of body
- Endothelial cells - extremely porous
- Colloidal osmotic pressure of plasma proteins
- Low capillary pressure
- Proximity to uriniferous tubules

About 85% of the water and sodium of the glomerular filtrate is resorbed by the proximal convoluted tubule and passes back into the bloodstream via the peritubular capillaries.

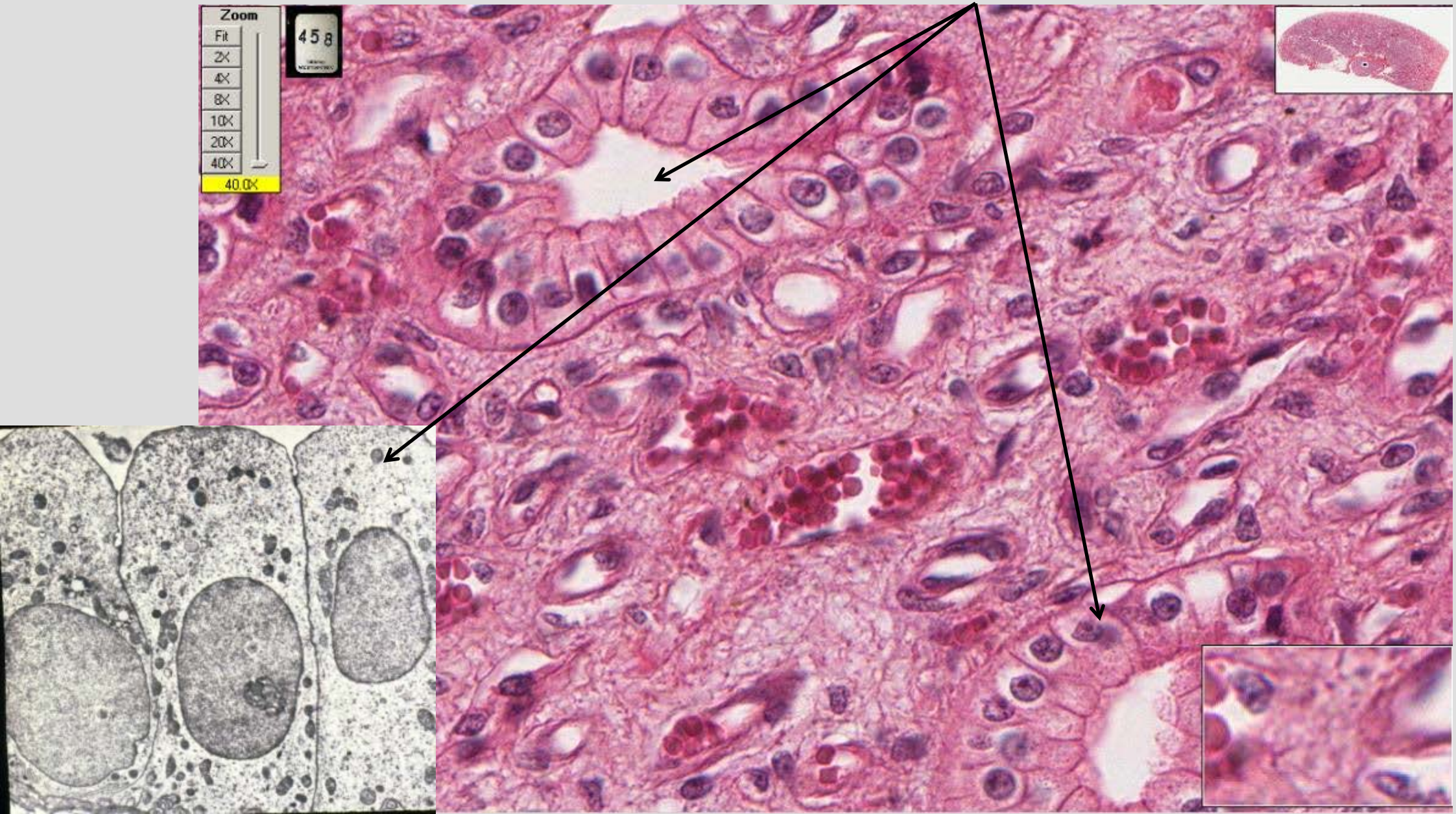


https://www.google.com/search?q=evolution+of+kidney+by+smith&source=lnms&tbm=isch&sa=X&ved=0ahUKEwid-vS72M3YAhVS6GMKHfFCC2AQ_AUICigB#imgrc=_TLN_3GCOgt6RM:

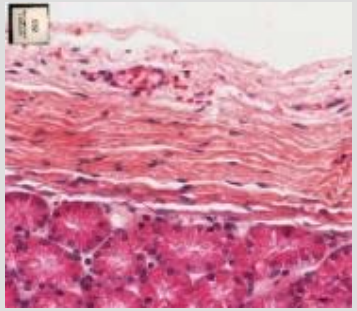
Kidney medulla



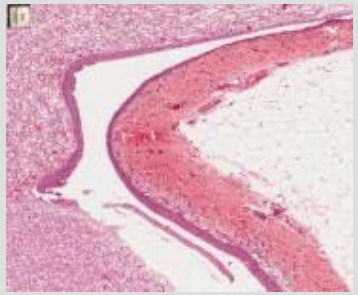
458 kidney



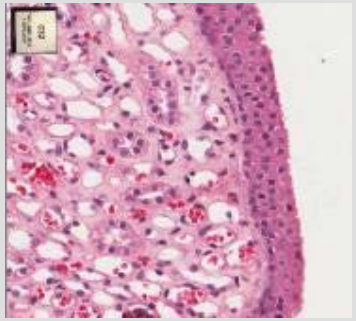
Slide Histo 032: Kidney (H&E)



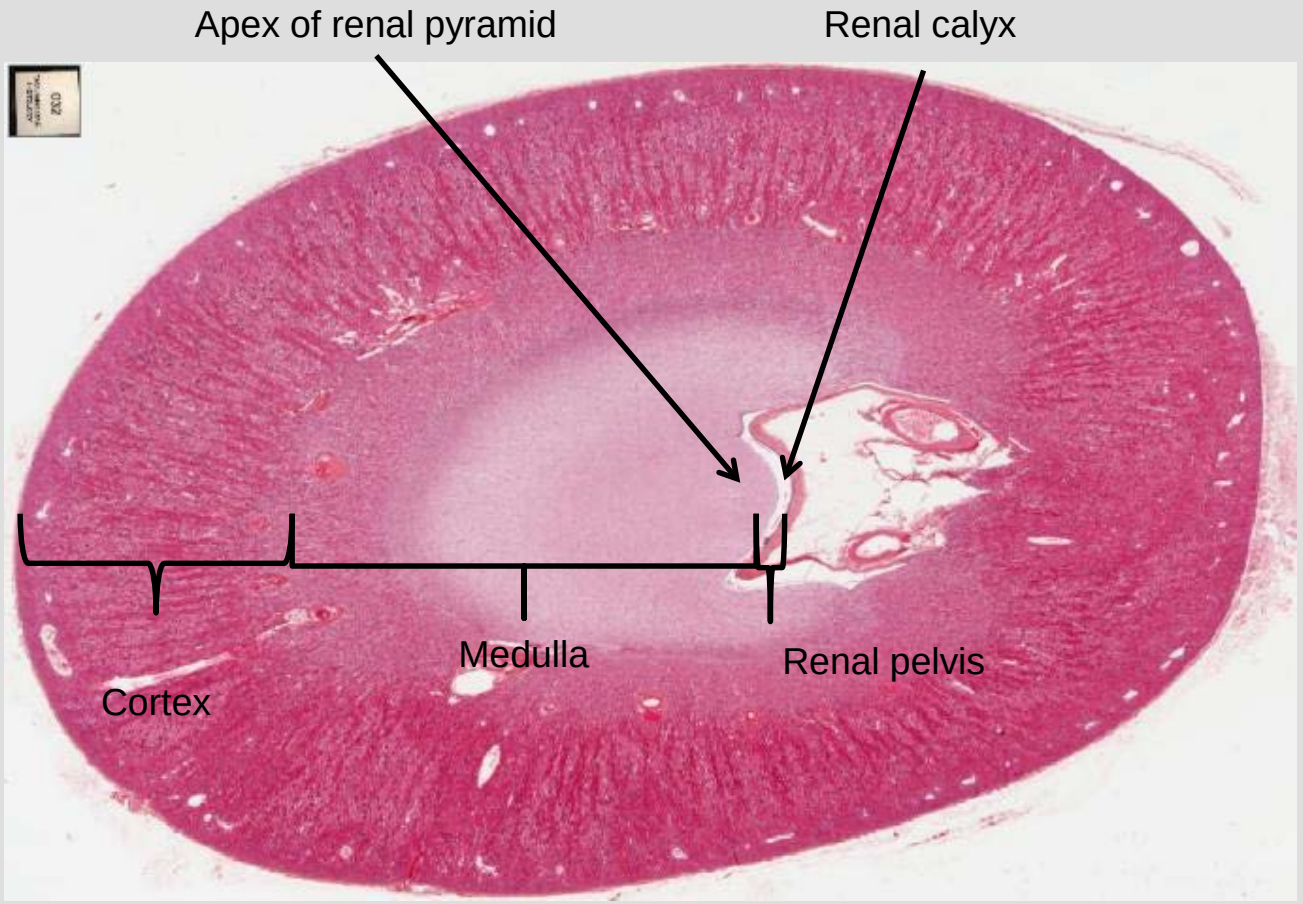
CT adventia capsule



Renal pyramind and calyx

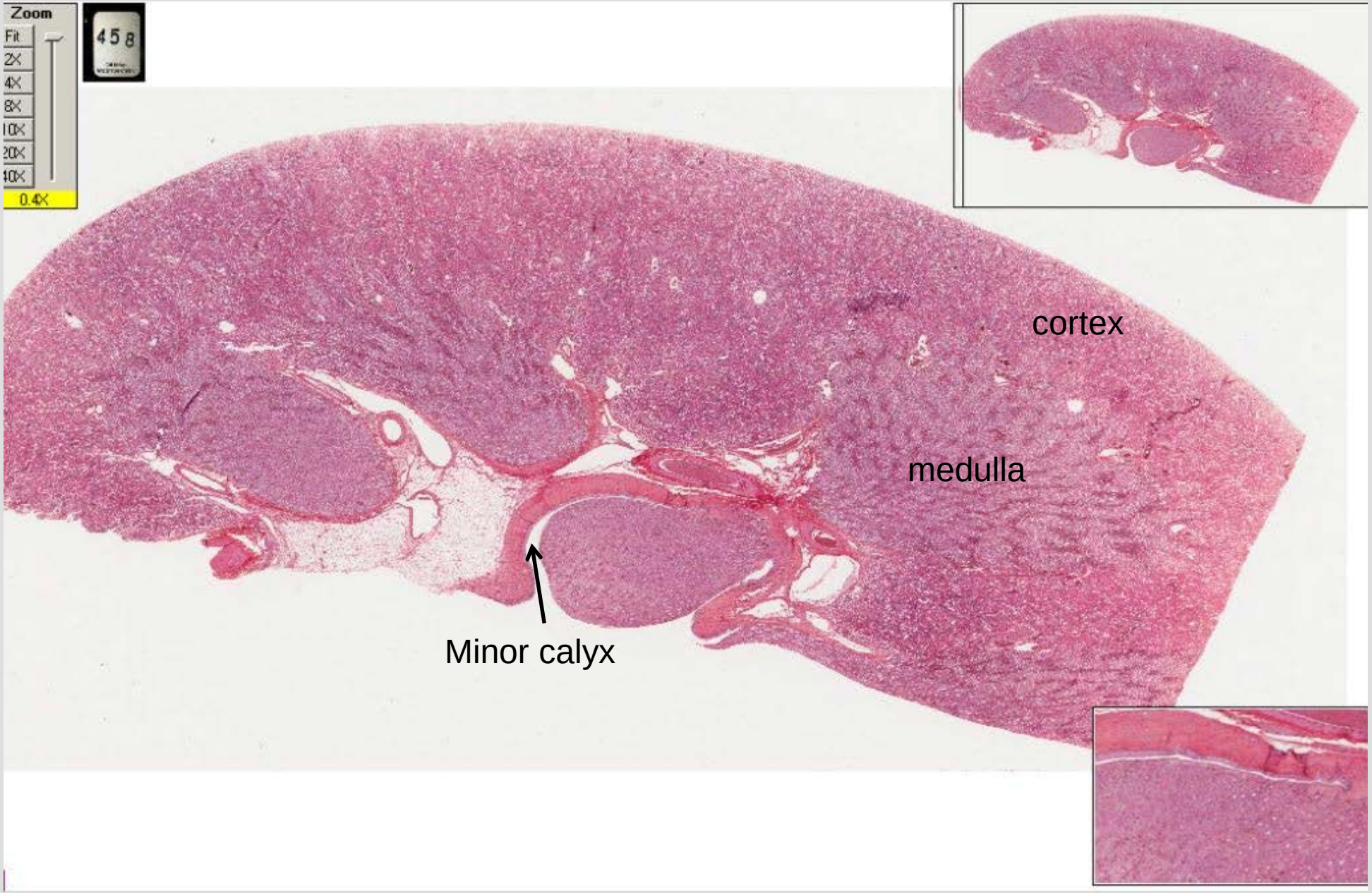


Simple columnar to transitional-like epithelium of pyramid



Histo32

458 kidney


Zoom
Fit
2X
4X
8X
10X
20X
40X
0.4X
458
cortex
medulla
Minor calyx

Ref code
4, 5, 14, 19

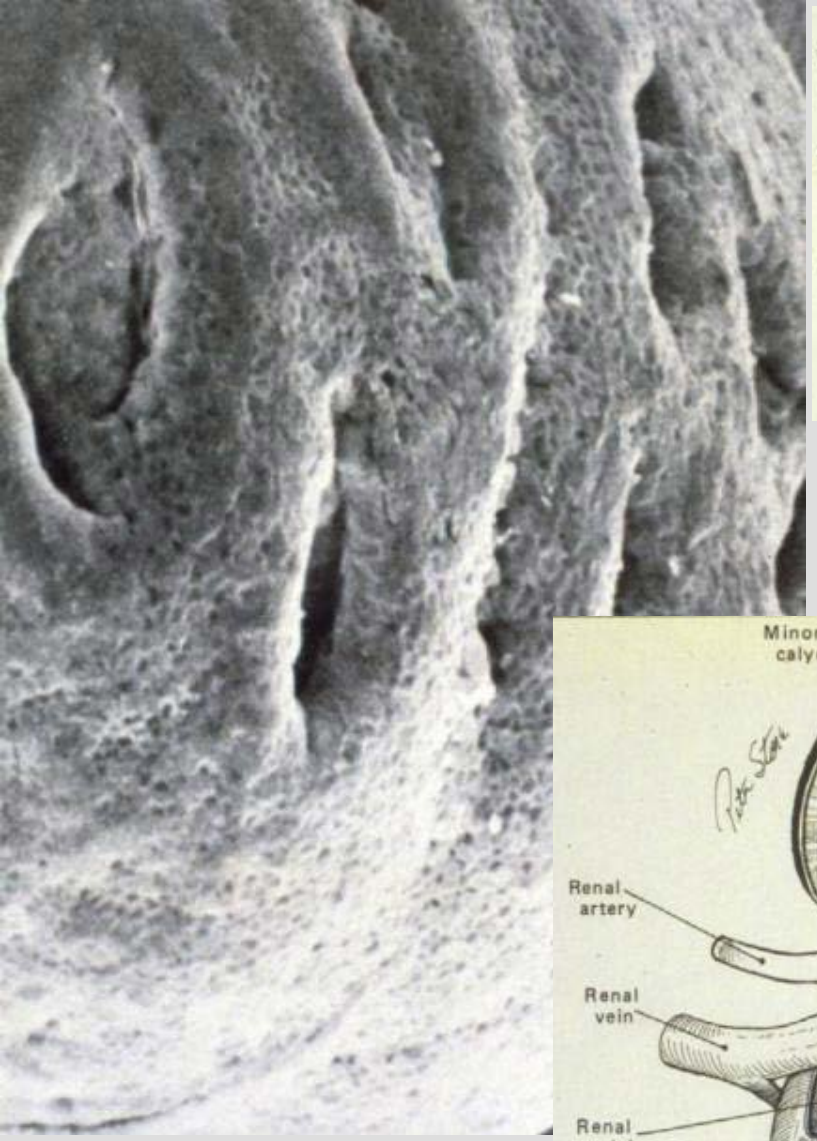
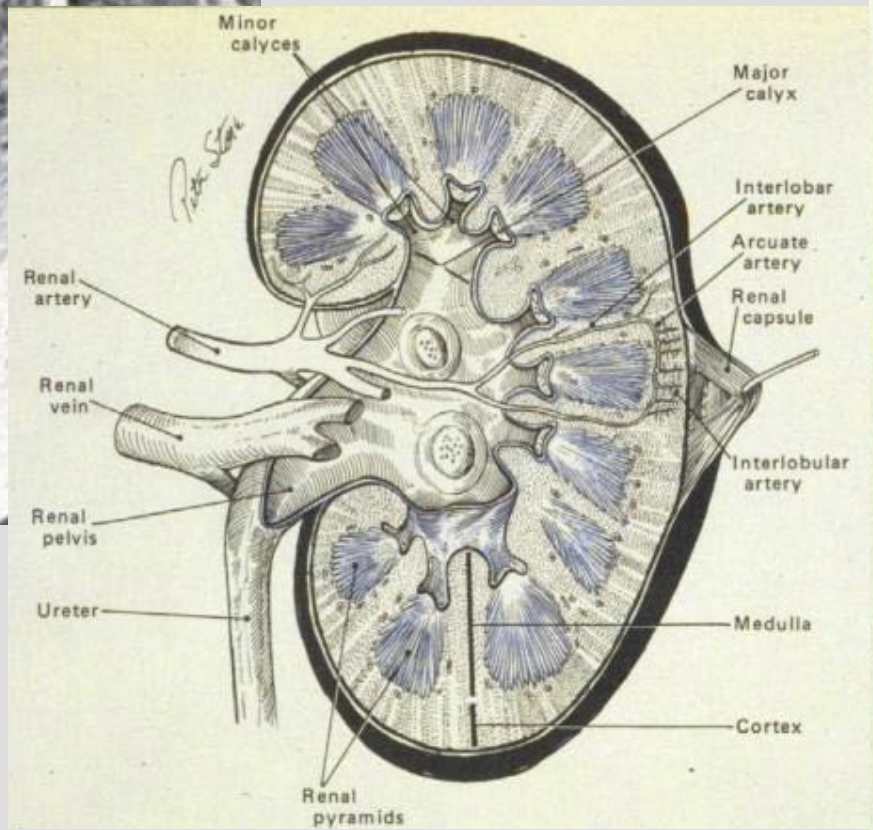
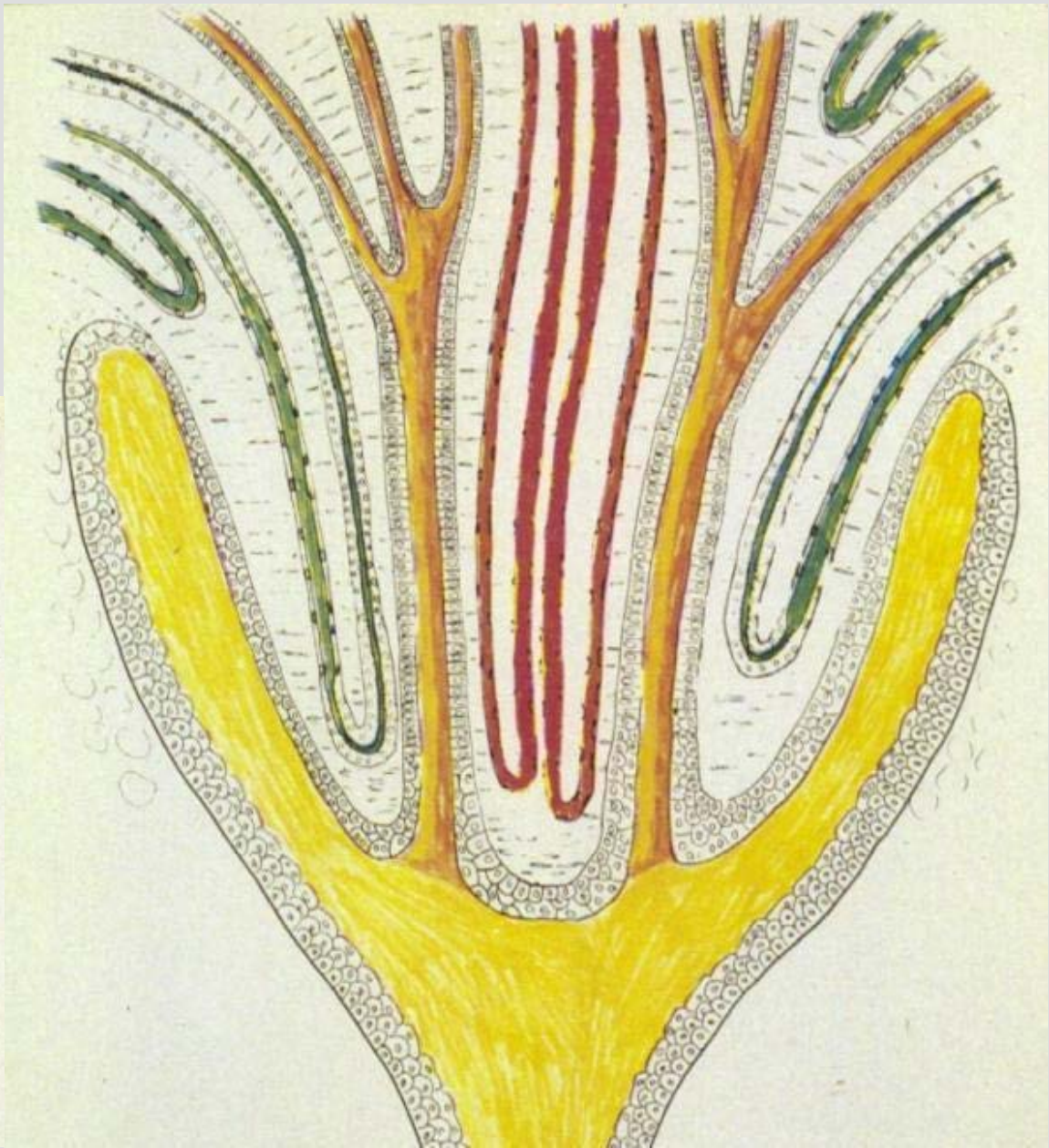
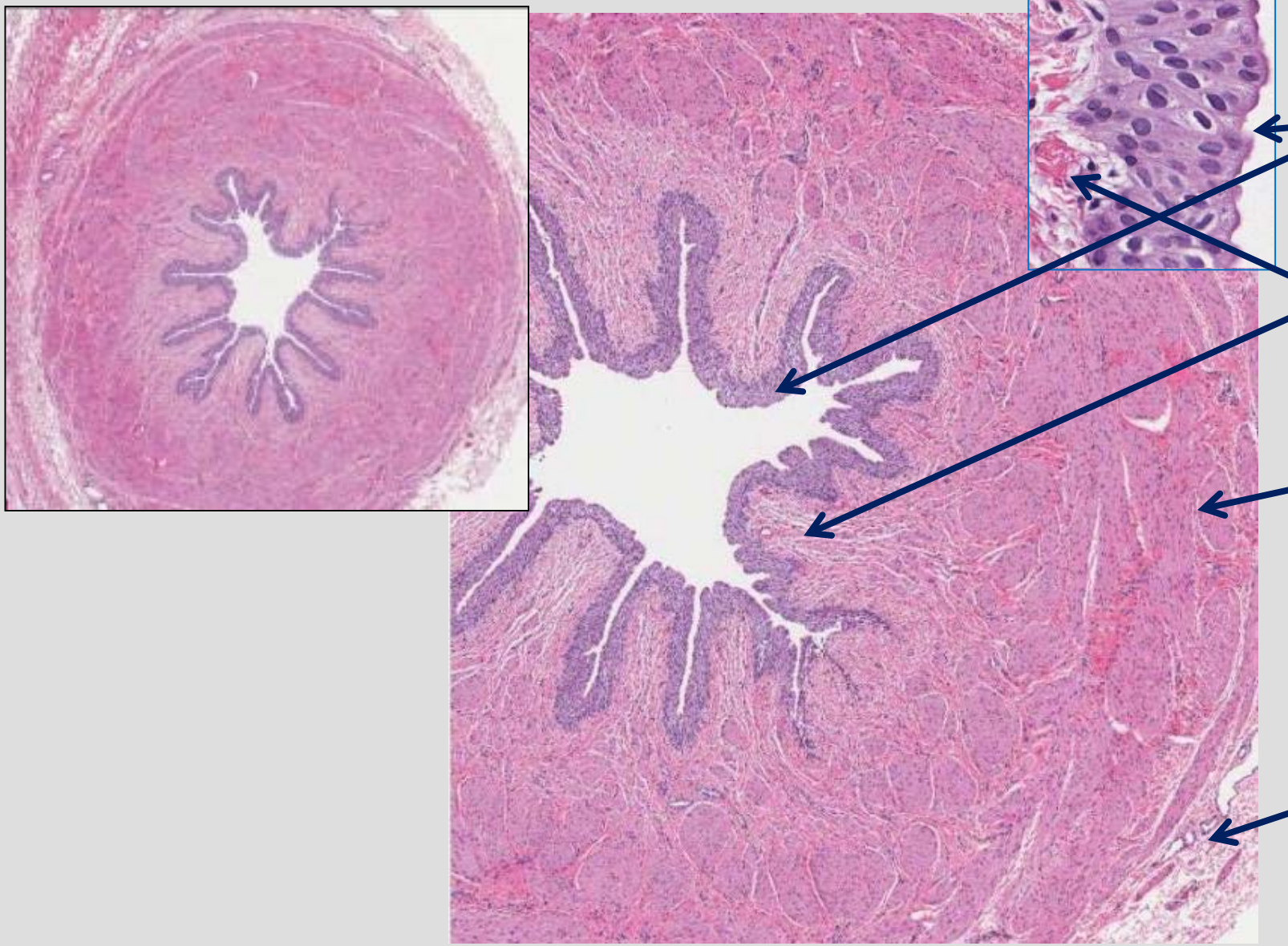


FIG. 2. *Papilla, longitudinal section through an area adjacent to a calyx.*
Stain: hematoxylin-eosin. 120×.





Ureter – transitional epithelium and smooth muscle



Ureters have three coats:

1) a mucous membrane consisting of transitional epithelium (4-5 cells thick) in longitudinal folds supported by a lamina propria of dense connective tissue,

2) a muscle coat with inner longitudinal and outer circular muscle fibers (an outermost layer of longitudinal fibers may also be present), and

3) an adventitial layer of fibroelastic connective tissue

Ref code
5

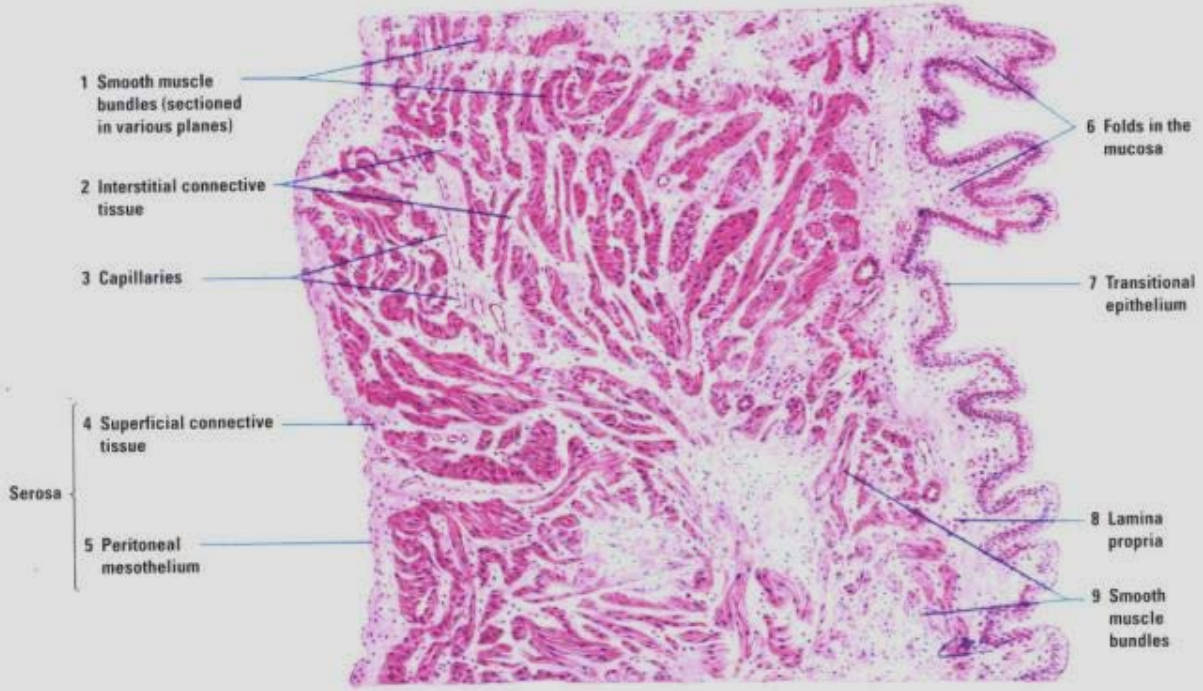


Fig. 15-8 Urinary Bladder: Wall (transverse section). Stain: hematoxylin-eosin. Low magnification.

Fig. 15-9 Urinary Bladder: Mucosa (transverse section). Stain: hematoxylin-eosin. Medium magnification.

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EROSCHENKO

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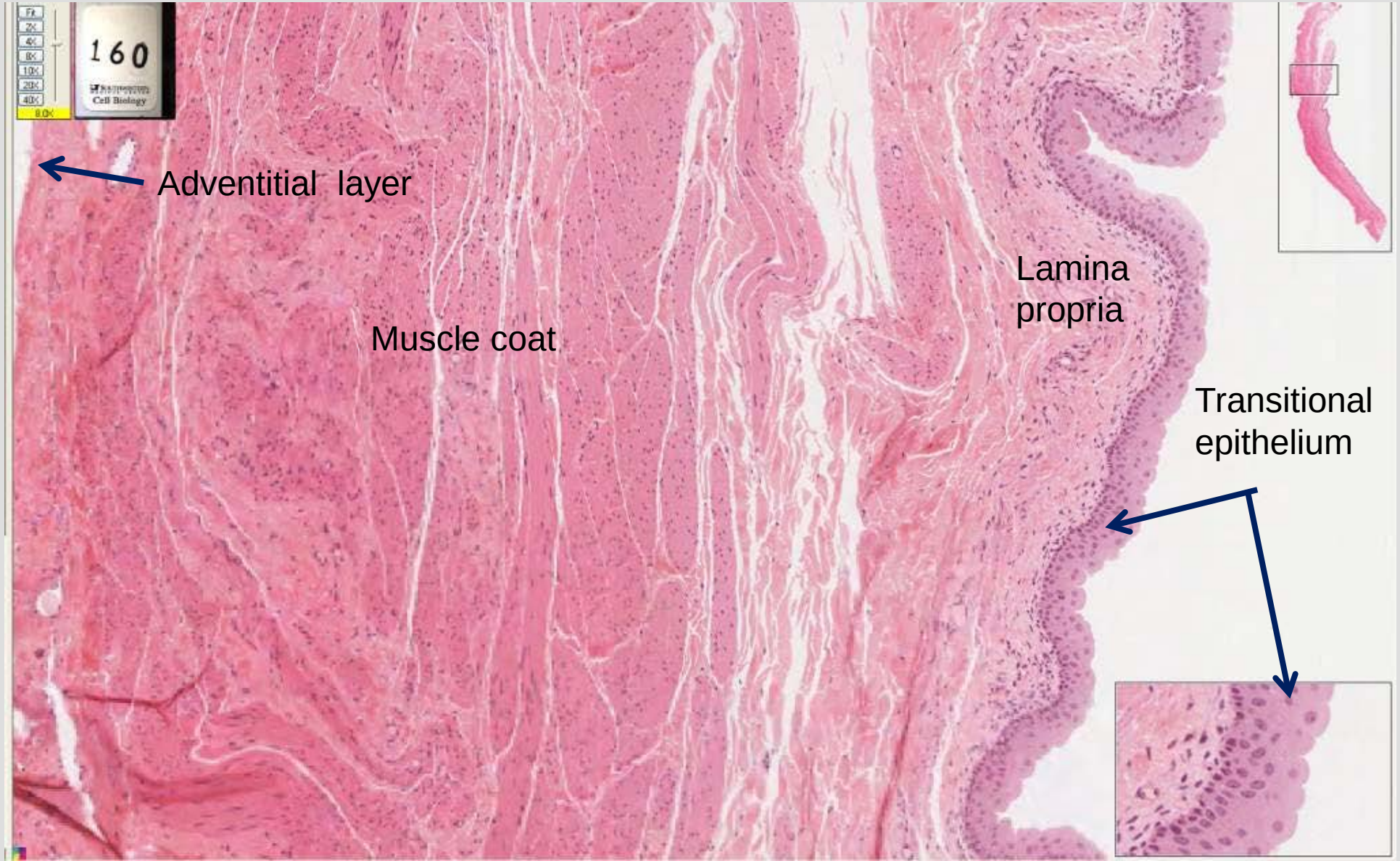
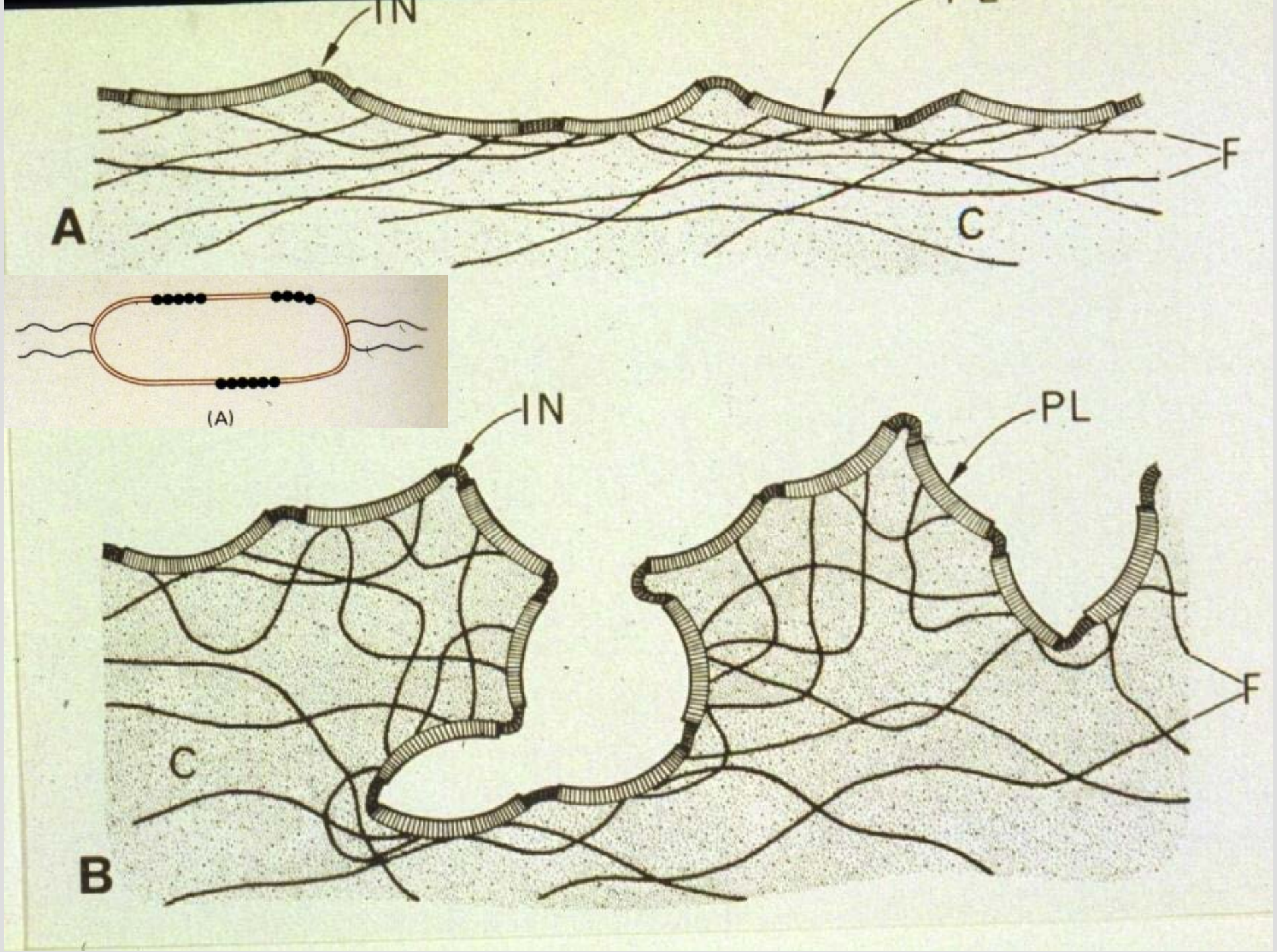
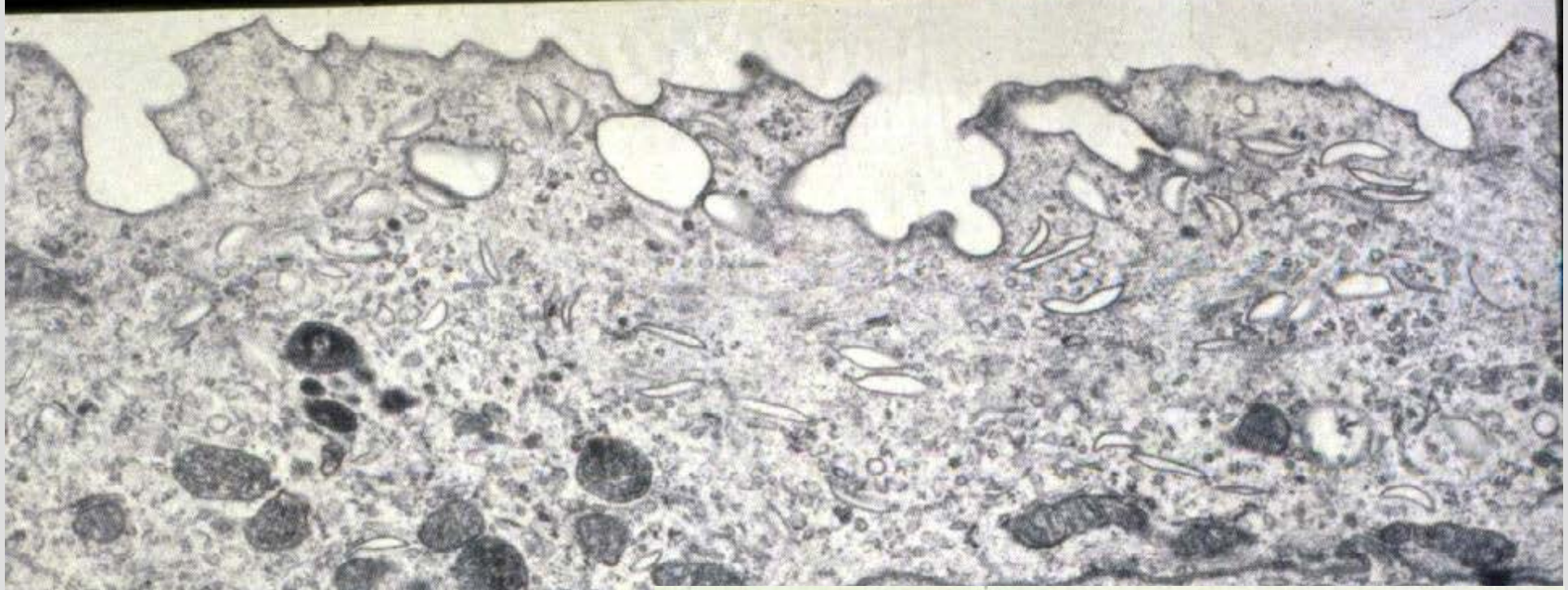
Urinary bladder, monkey

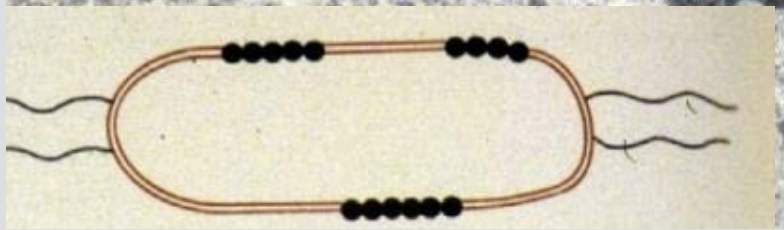


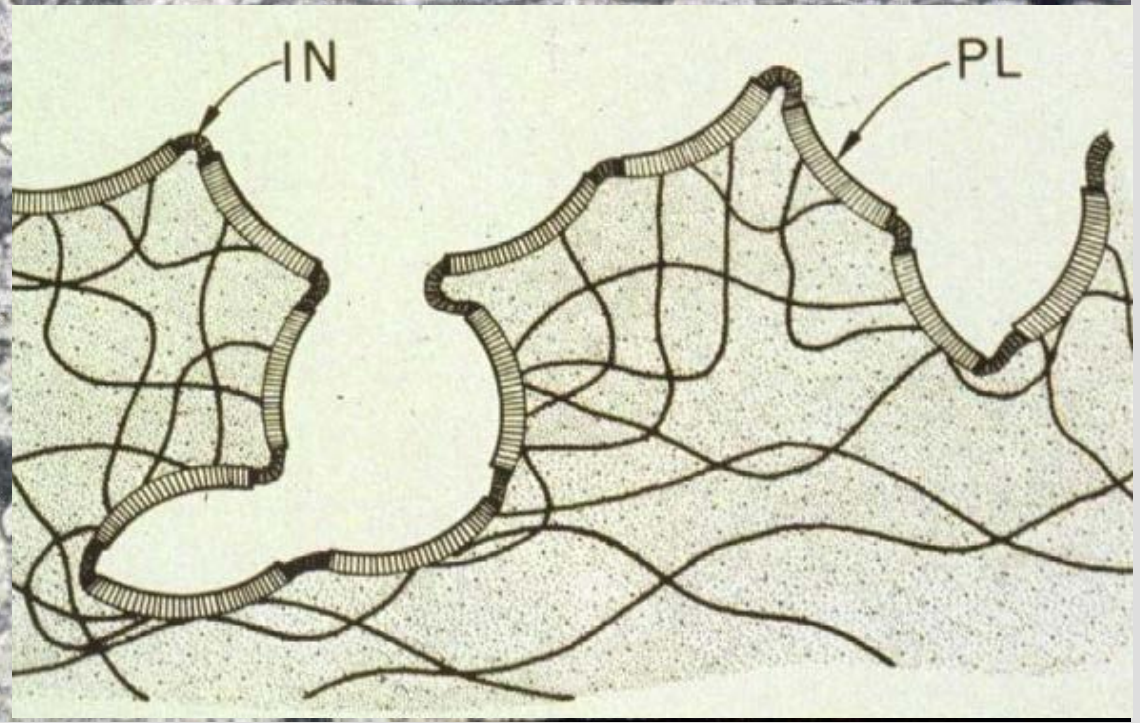
Ref code
1, 9



Ref code
1, 6, 9







Ref code
5

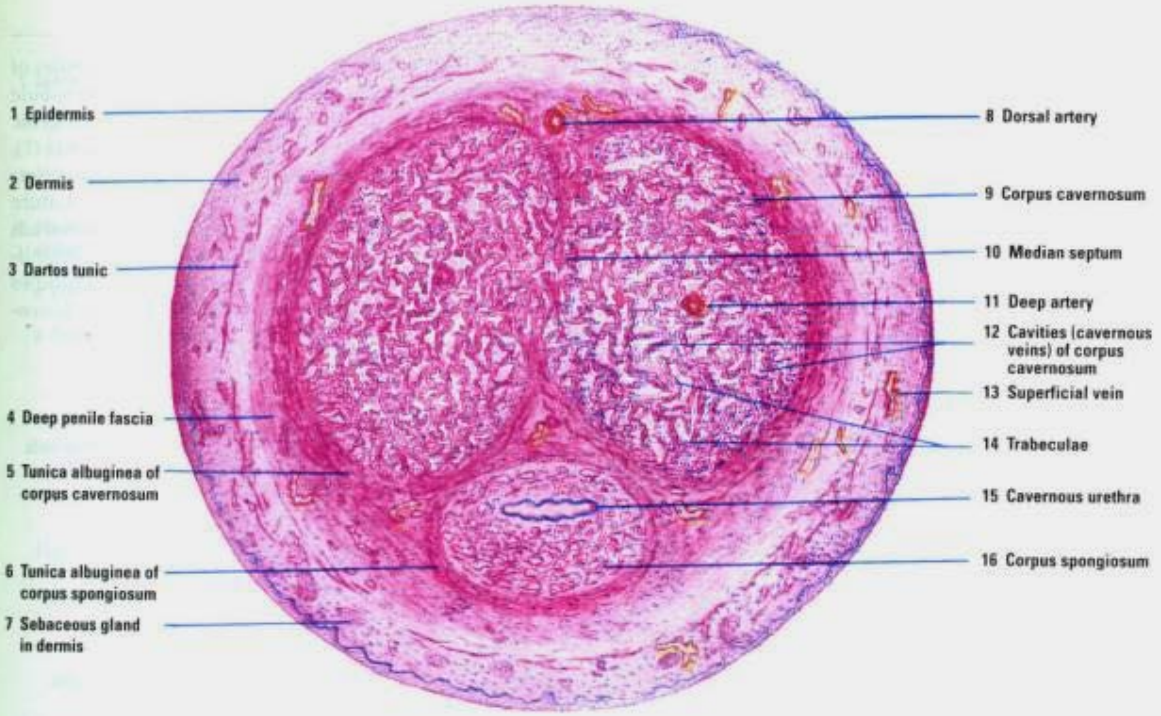


Fig. 17-13 Penis (transverse section). Stain: hematoxylin-eosin. Low magnification.

Fig. 17-14 Cavernous Urethra (transverse section). Stain: hematoxylin-eosin. Low magnification.

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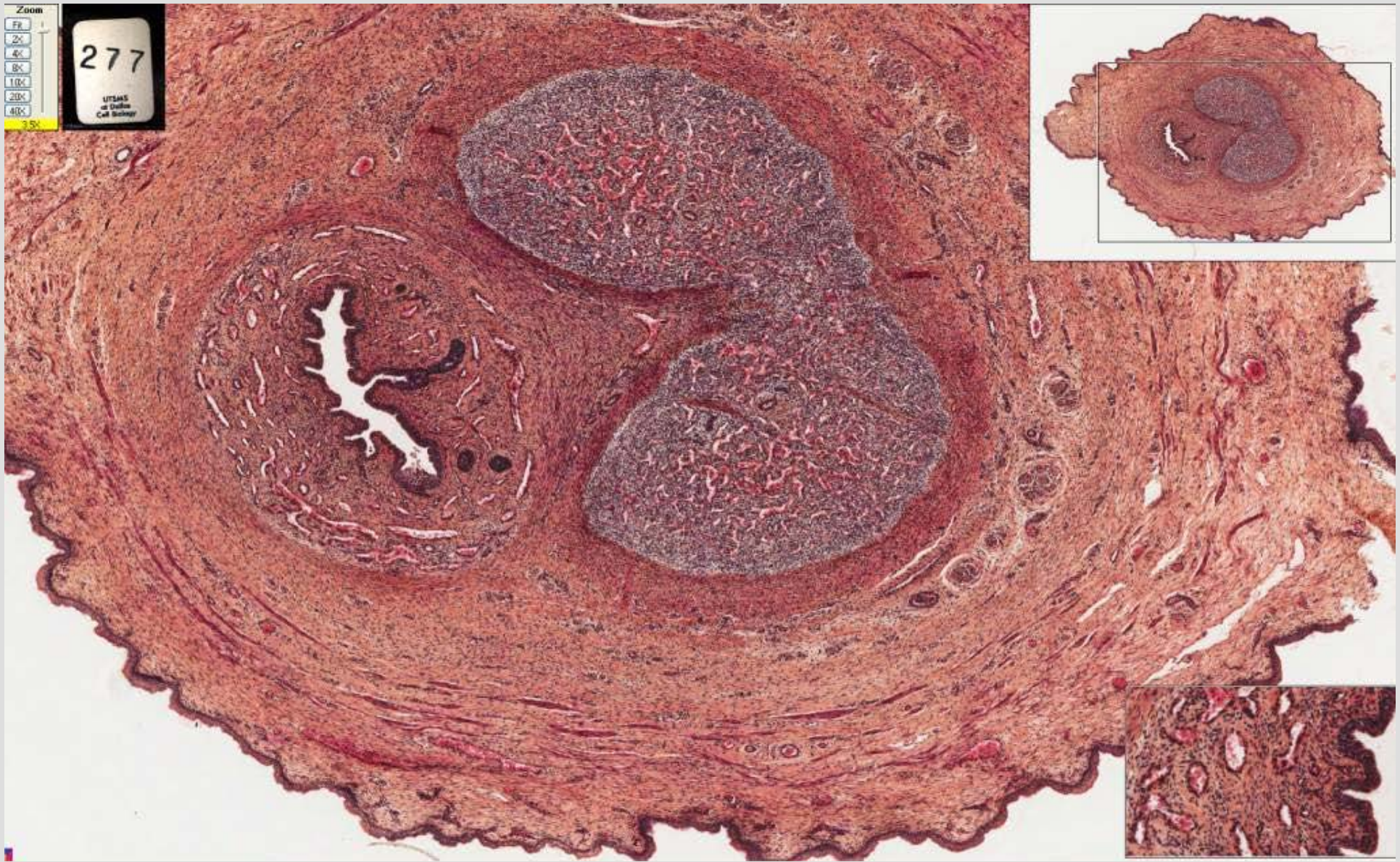
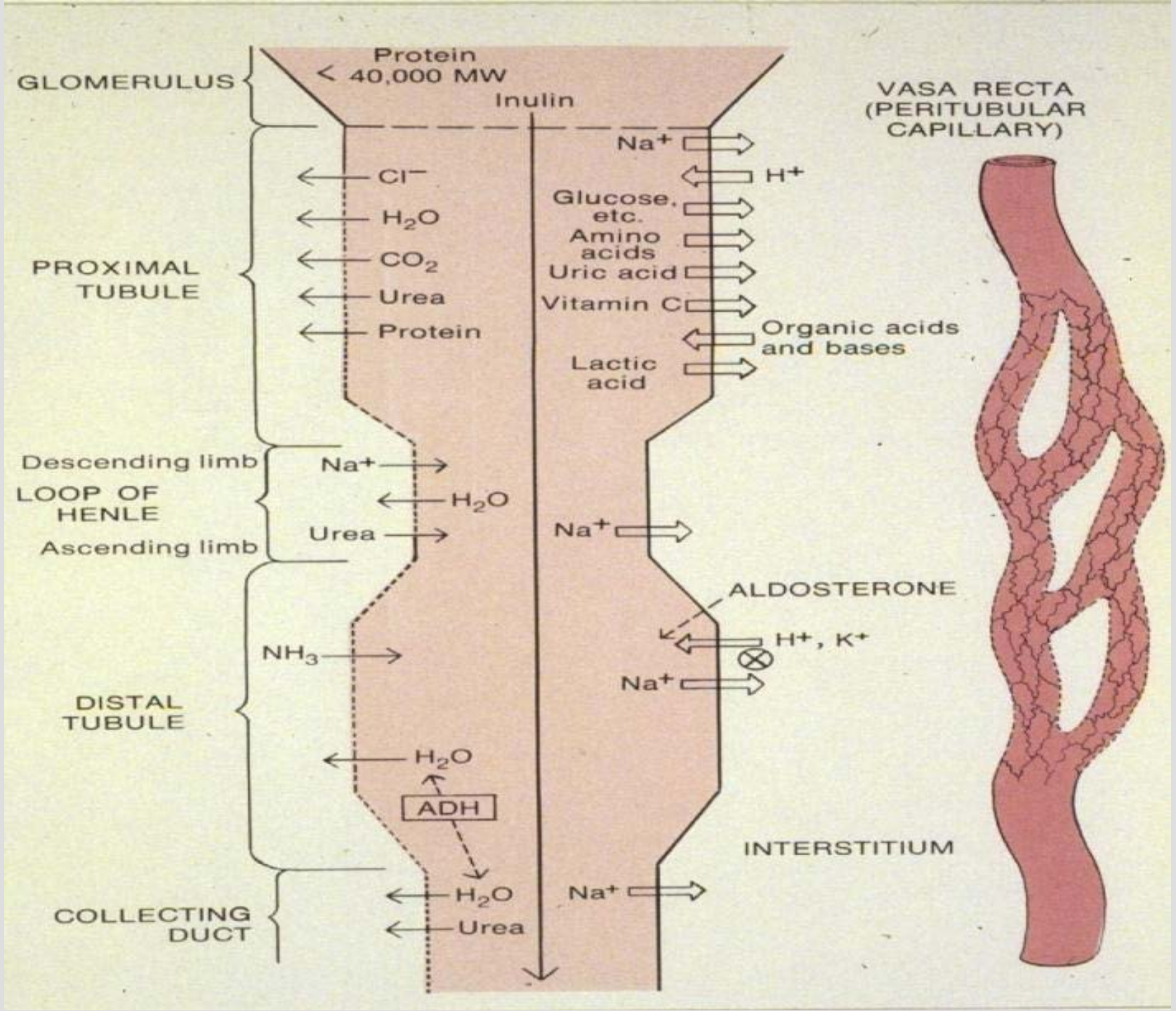
EROSCHENKO

277 Human Penis – transitional epithelium and surrounding spongy cavernous of penal urethra

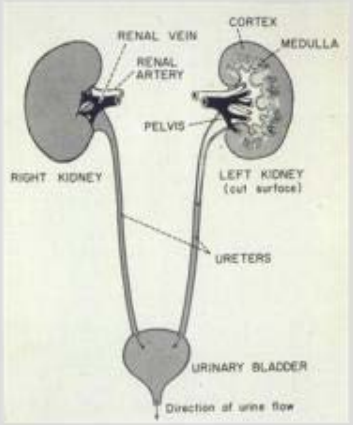


Ref code
16


GLOMERULUS
Protein
< 40,000 MW
Inulin
VASA RECTA
(PERITUBULAR
CAPILLARY)
PROXIMAL
TUBULE
Cl⁻
H₂O
CO₂
Urea
Protein
Na⁺
H⁺
Glucose,
etc.
Amino
acids
Uric acid
Vitamin C
Organic acids
and bases
Lactic
acid
Descending limb
LOOP OF
HENLE
Ascending limb
Na⁺
H₂O
Urea
Na⁺
ALDOSTERONE
H⁺, K⁺
Na⁺
NH₃
DISTAL
TUBULE
H₂O
ADH
INTERSTITIUM
H₂O
Urea
Na⁺
COLLECTING
DUCT

In summary

Function of Urinary System: Homeostasis



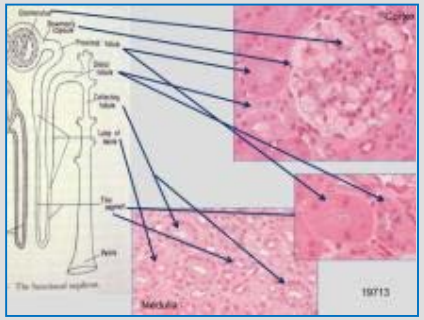
Rid body of waste (urea, uric acid, creatinine, salts)

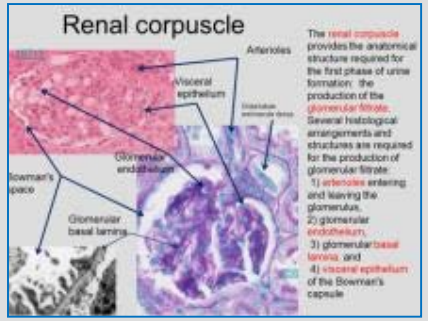
Preserves constancy of extracellular fluid in composition, volume, and pH

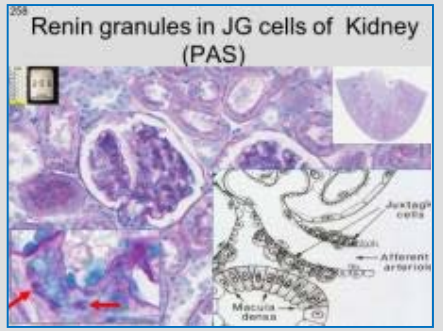
Endocrine function

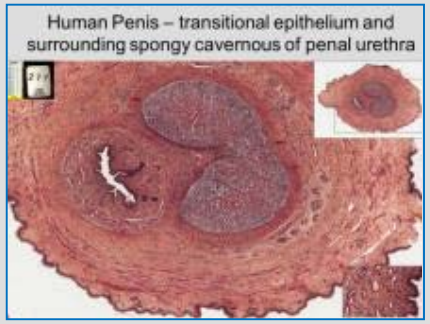
a) Secrete erythropoietin - red blood cell production

b) Produces renin - aldosterone release









Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

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Questions on the urinary system

Which of the following process - structure combination(s) of the urinary tract match?

a. filtration - renal corpuscle
b. reabsorption of proteins - proximal tubule
c. reabsorption of sugar - distal tubule
d. a and b
e. a, b, and c

Renal corpuscles

a. facilitate the interaction between the blood and uriniferous tubules
b. contain parietal cells that filters the blood
c. contain mesangial cells that has renin granules
d. a and b
e. a, b, and c

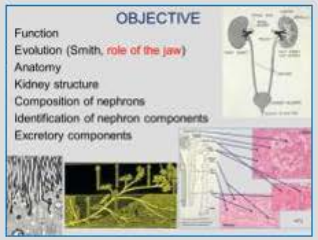
Which characteristics facilitate maximal filtration of the glomerulus?

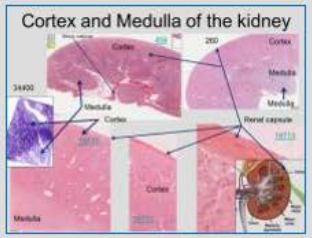
a. large filter
b. thin filter
c. high blood pressure created by difference in the caliber of the afferent and efferent arterioles
d. a and b
e. a, b, and c

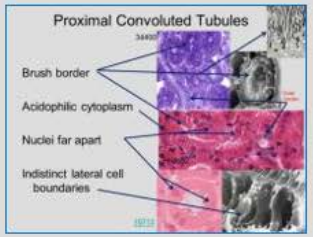
The end of

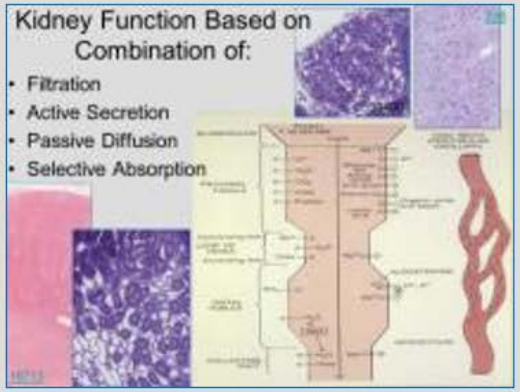
Medical School Histology Basics
Urinary System

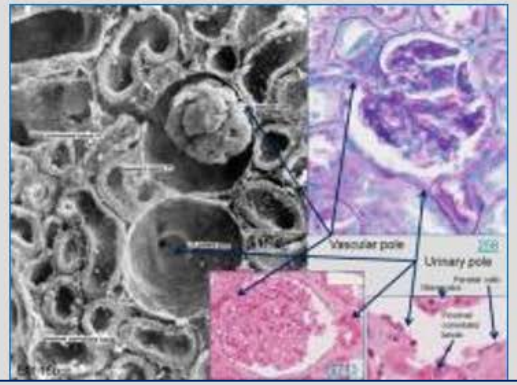
VIBS 243 lab

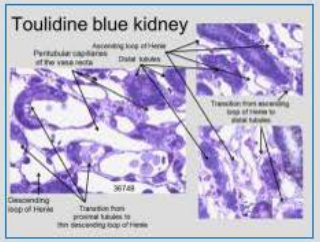


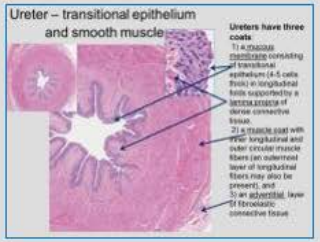


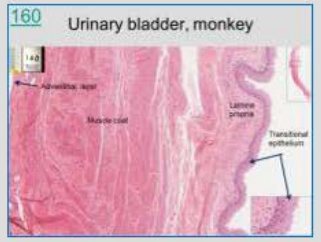












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