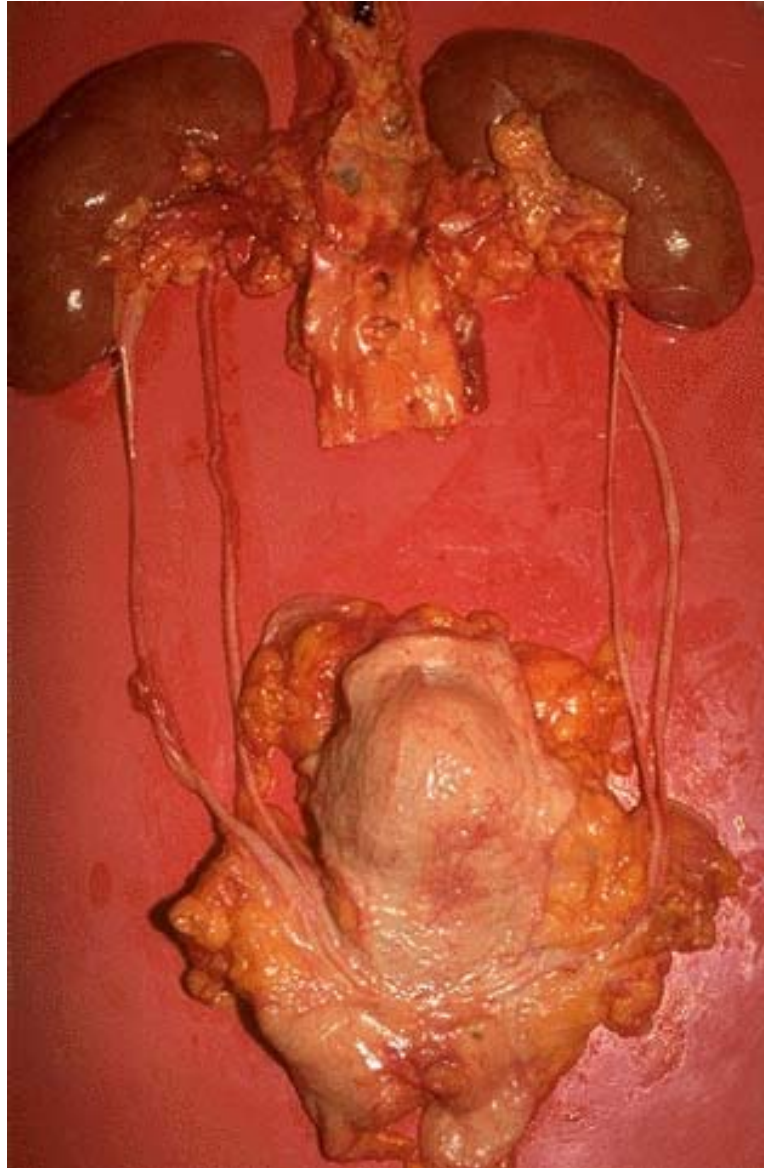


The Urinary System



General

- Urinary system
 - Maintains fluid homeostasis including:
 - regulation of volume and composition by eliminating certain wastes while conserving needed materials
 - regulation of blood pH
 - regulation of hydrostatic pressure of blood and, indirectly, of other body fluids
 - Contributions to metabolism
 - helps synthesize calcitriol (active form of Vitamin D)
 - secretes erythropoietin
 - performs gluconeogenesis during fasting or starvation
 - deaminates certain amino acids to eliminate ammonia

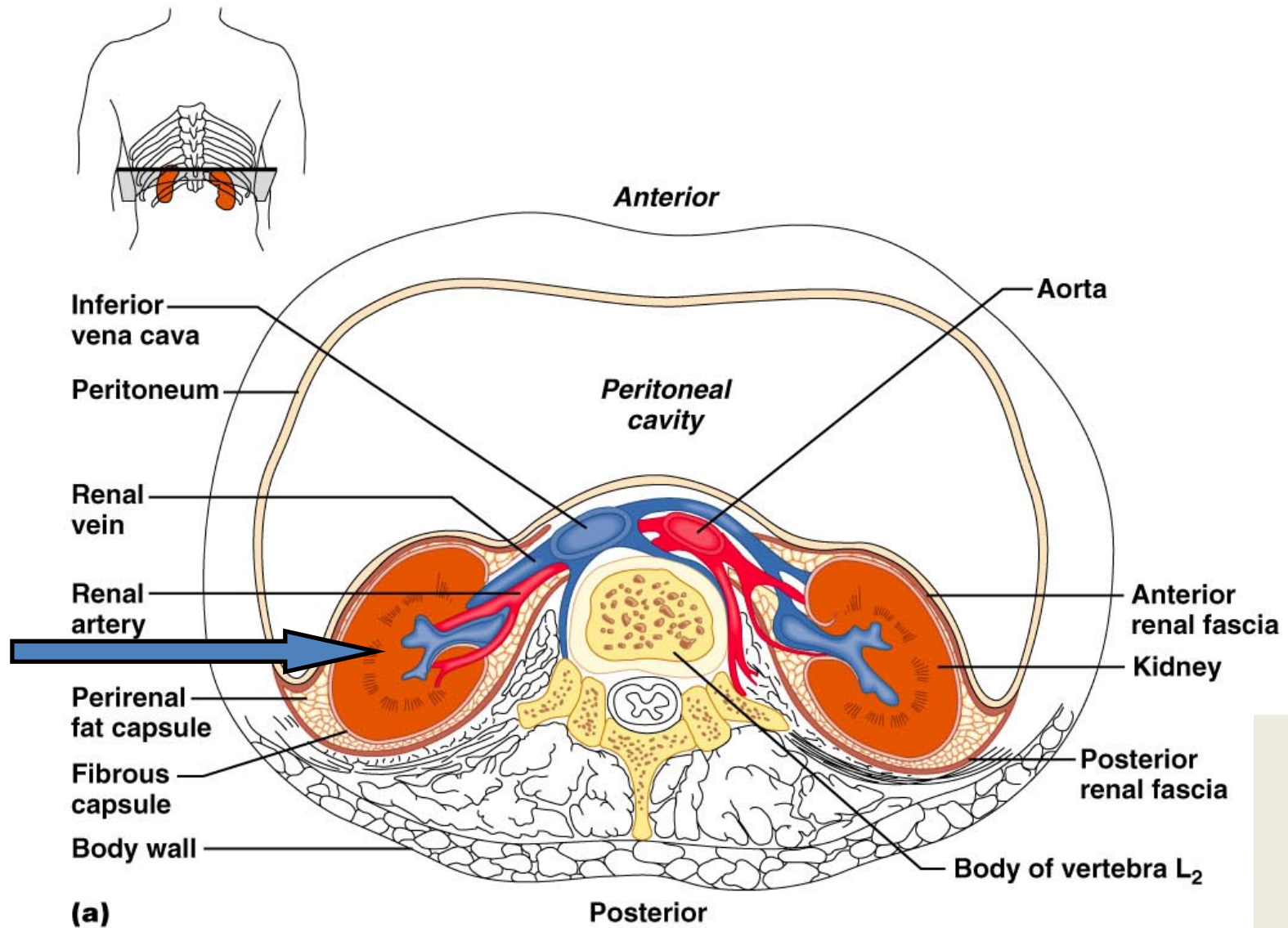
Kidneys

- Paired reddish organs, just above waist on posterior wall of abdomen
 - partially protected by 11th, 12th ribs
 - right kidney sits lower than the left kidney
 - receive 20-25% of the resting cardiac output
 - Consume 20-25% of the O_2 used by the body at rest

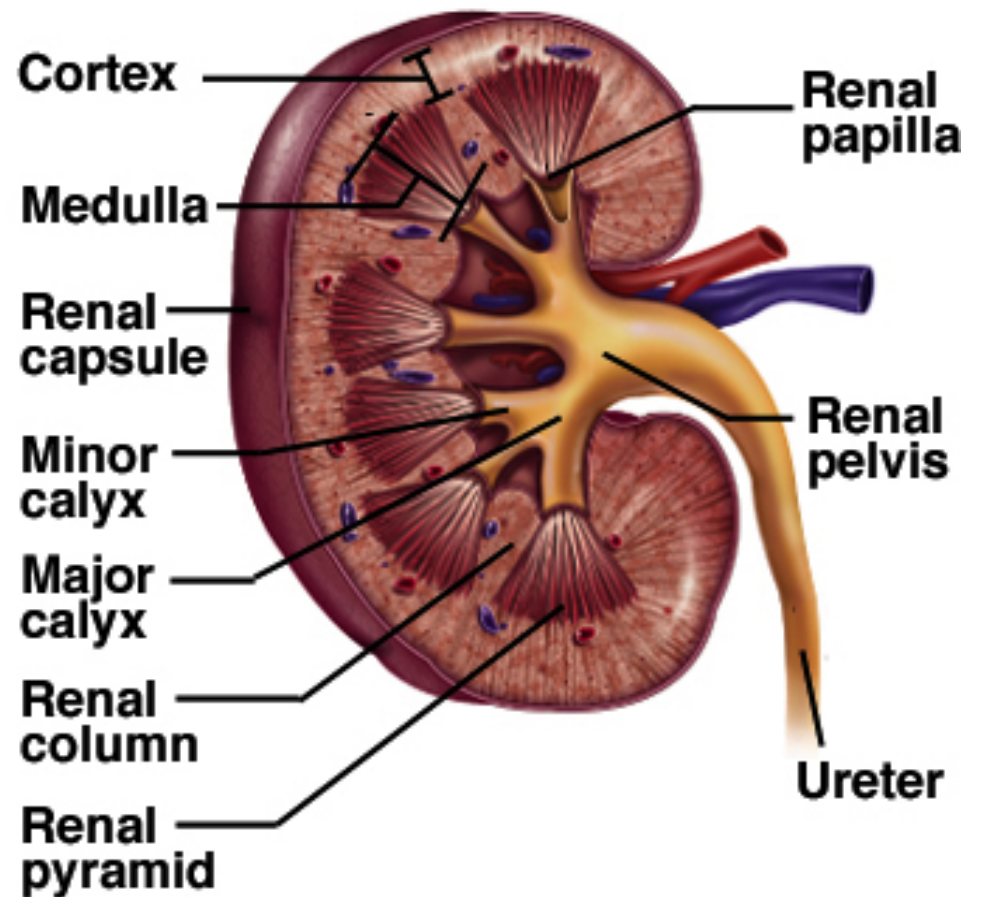


Kidneys (cont.)

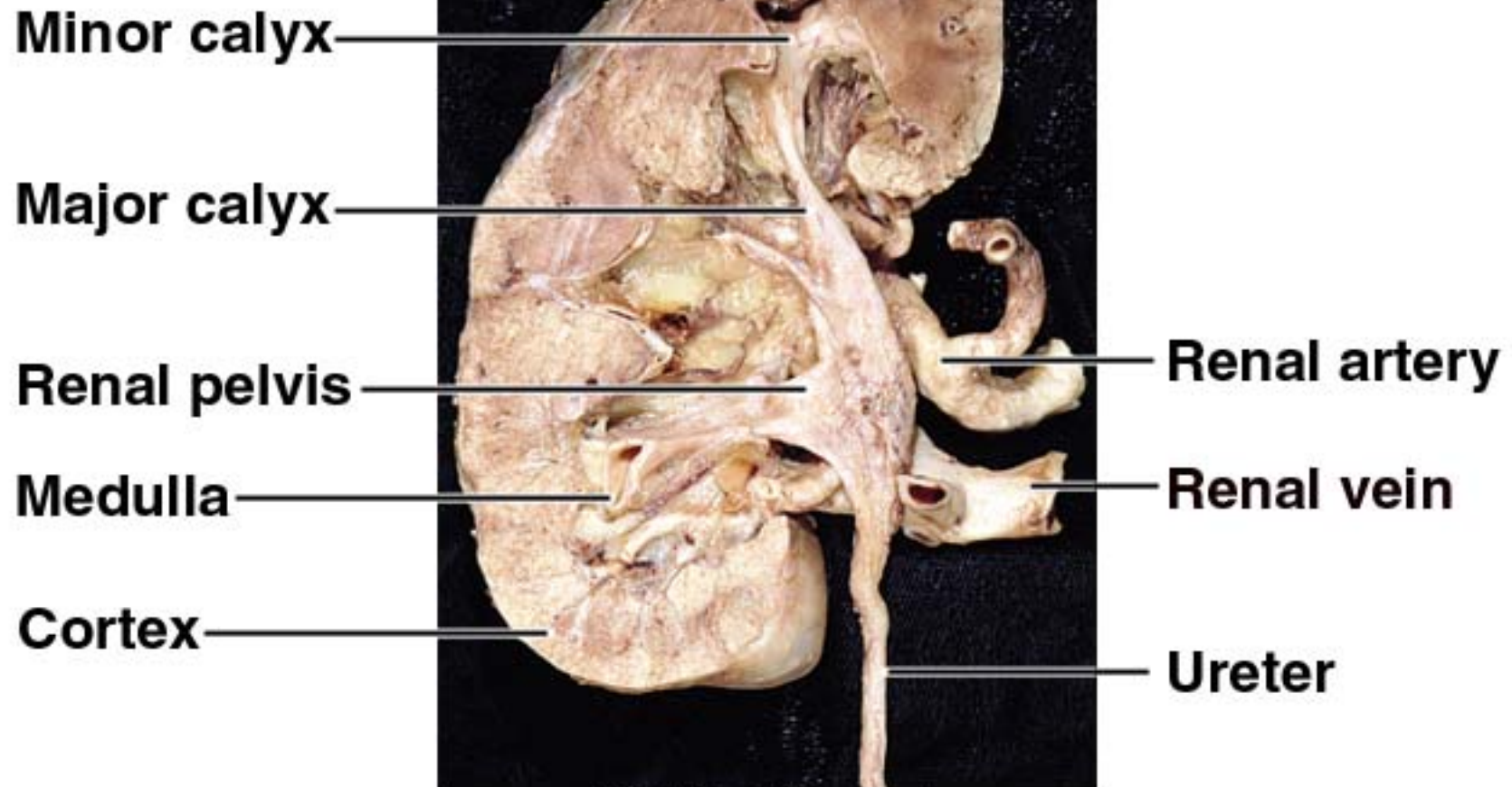
- Retroperitoneal, as are ureters and urinary bladder



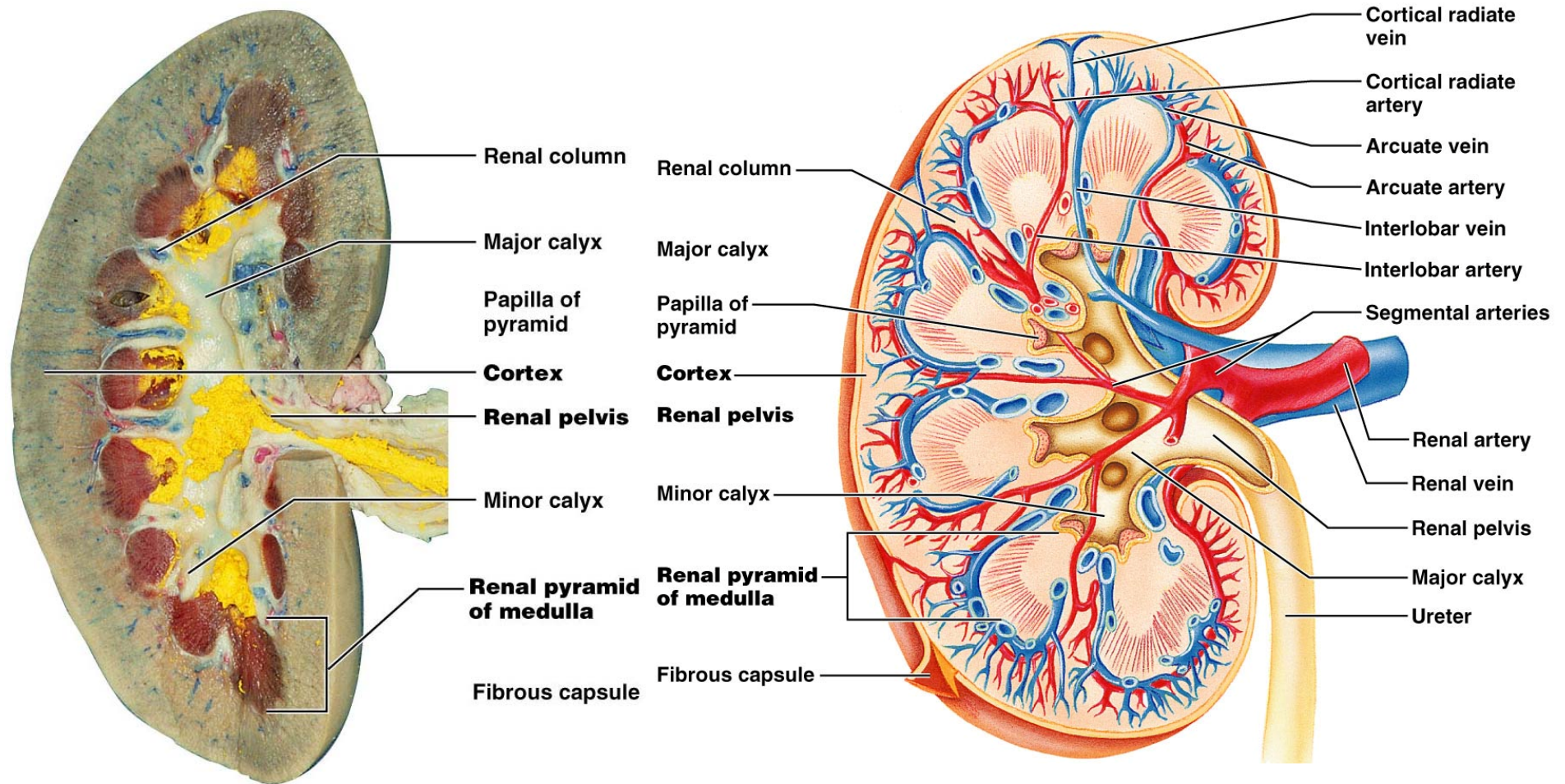
- Renal Pyramids
- Renal Columns
 - Space between pyramids within the medulla
- Renal Papilla
 - Narrow end of pyramid
- Calyx (ces)
 - Collecting tubes
- Renal Pelvis
 - Collecting vessel prior to ureter



Human Kidney

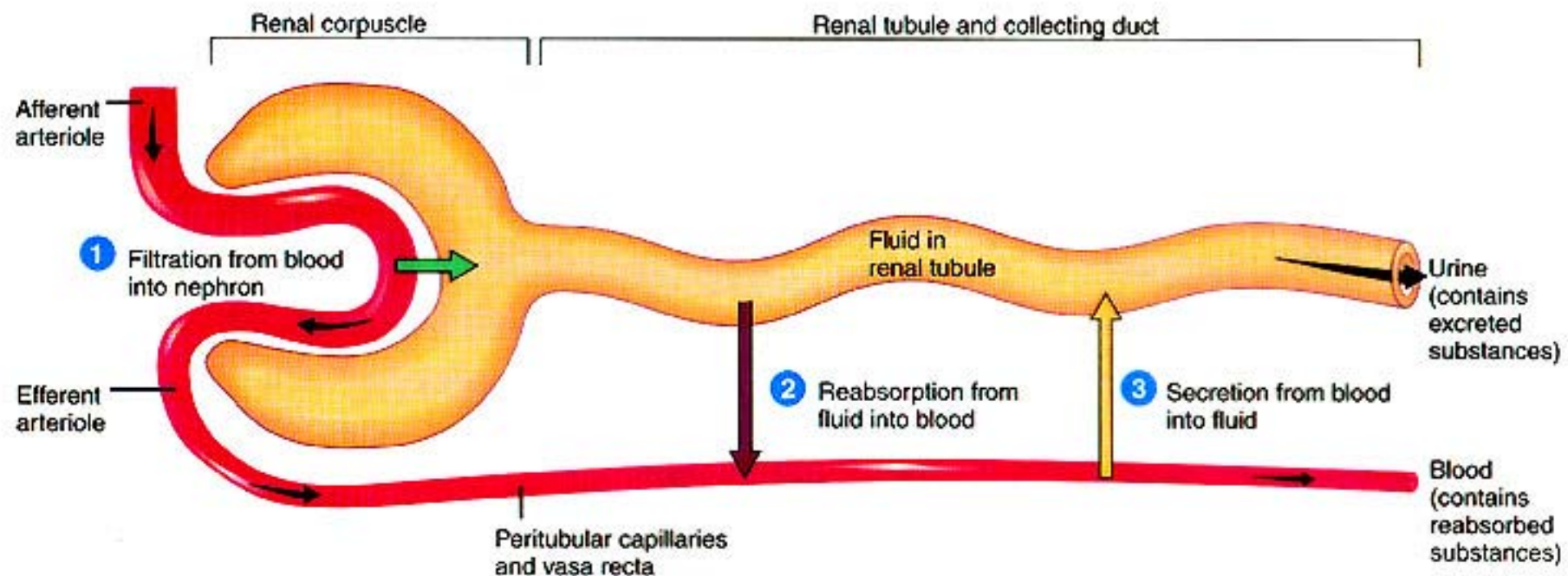


Kidney - Internal Gross Anatomy



Kidney - Internal Micro Anatomy

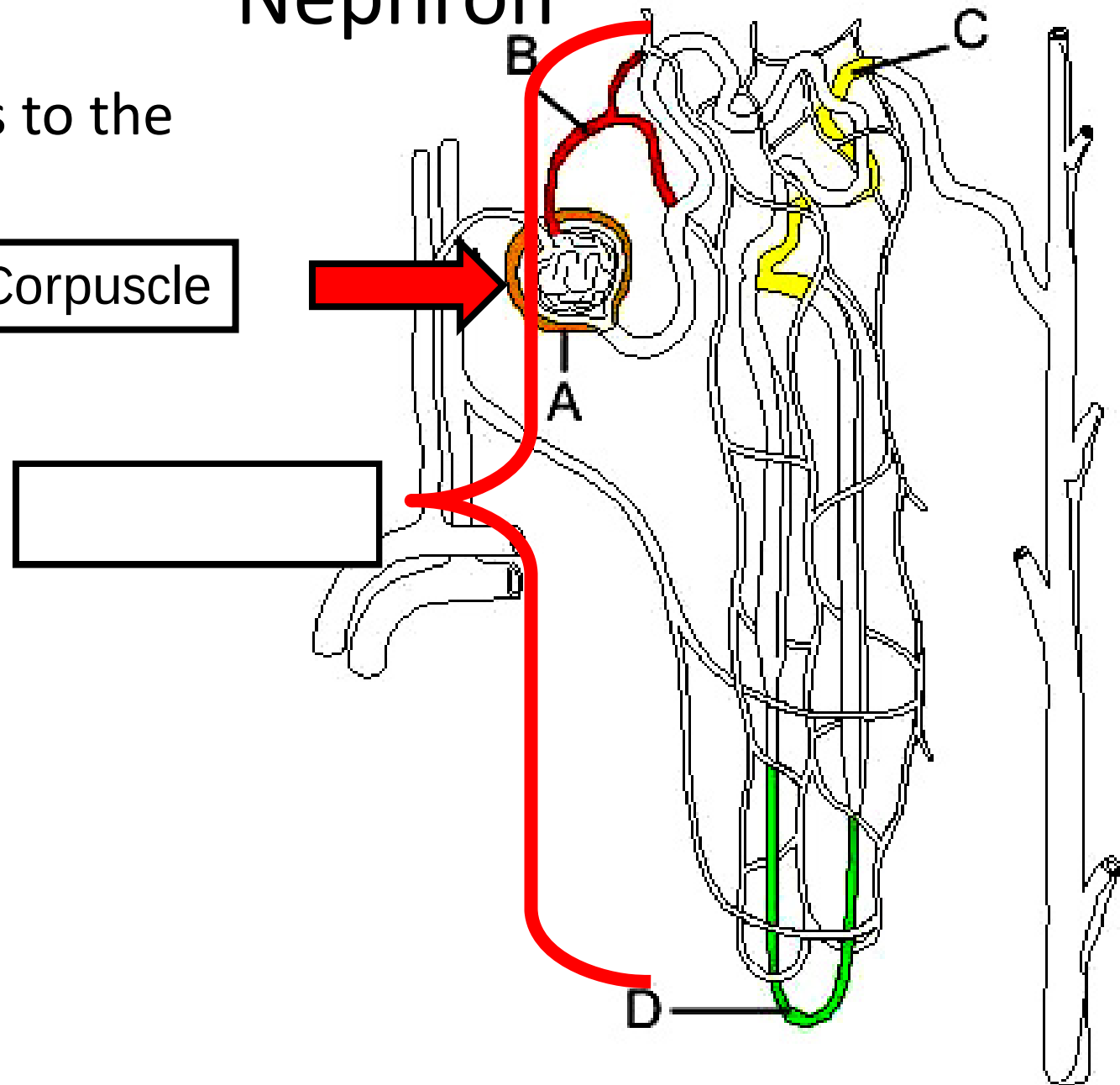
- Nephron – the functional unit of kidney
 - Three physiological processes: 1) filtration, 2) reabsorption , and 3) secretion
 - These three processes cooperate to achieve the various functions of the kidney
 - Different sites → different primary functions



Nephron

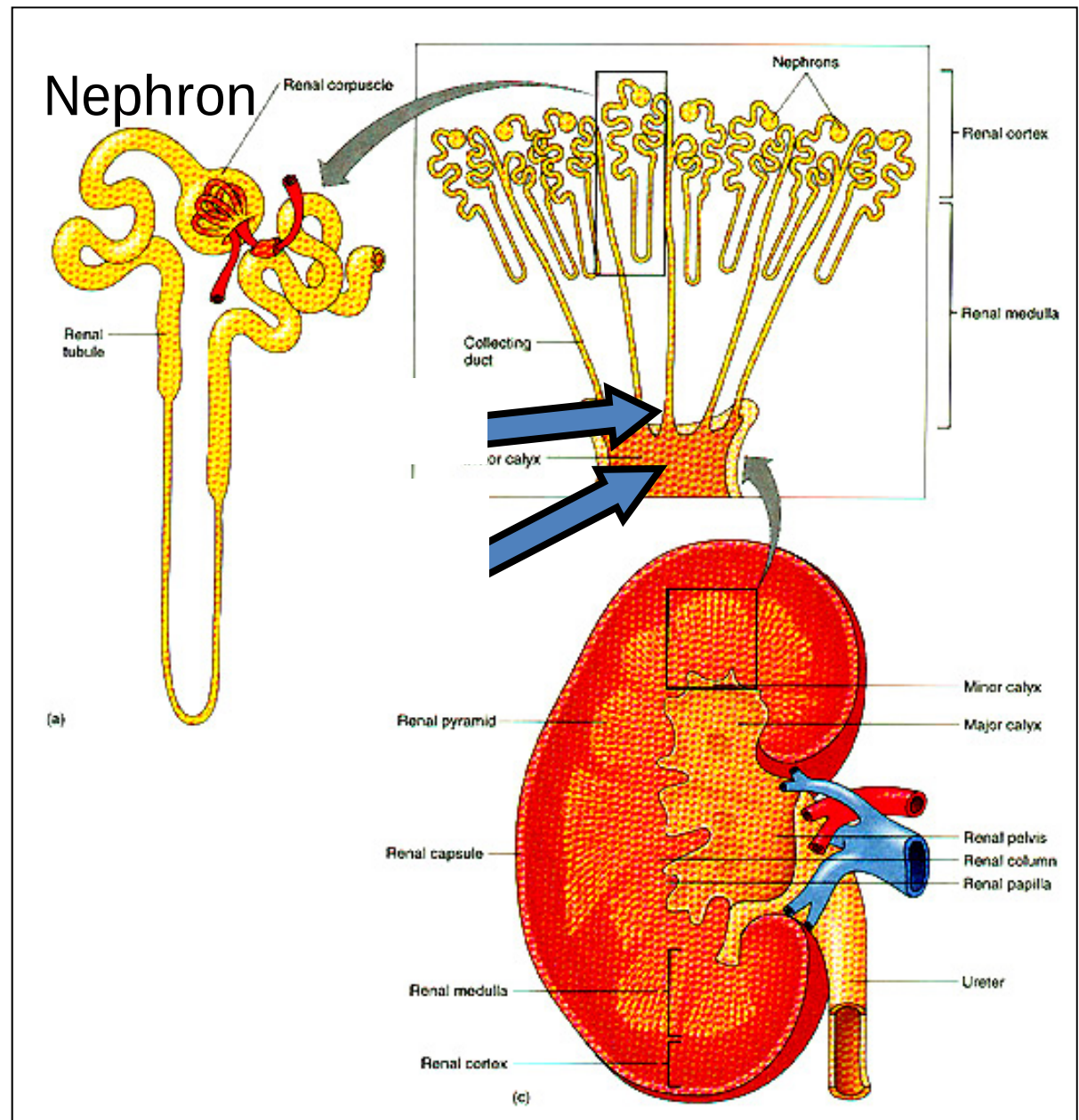
- 2 major parts to the nephron

Renal Corpuscle



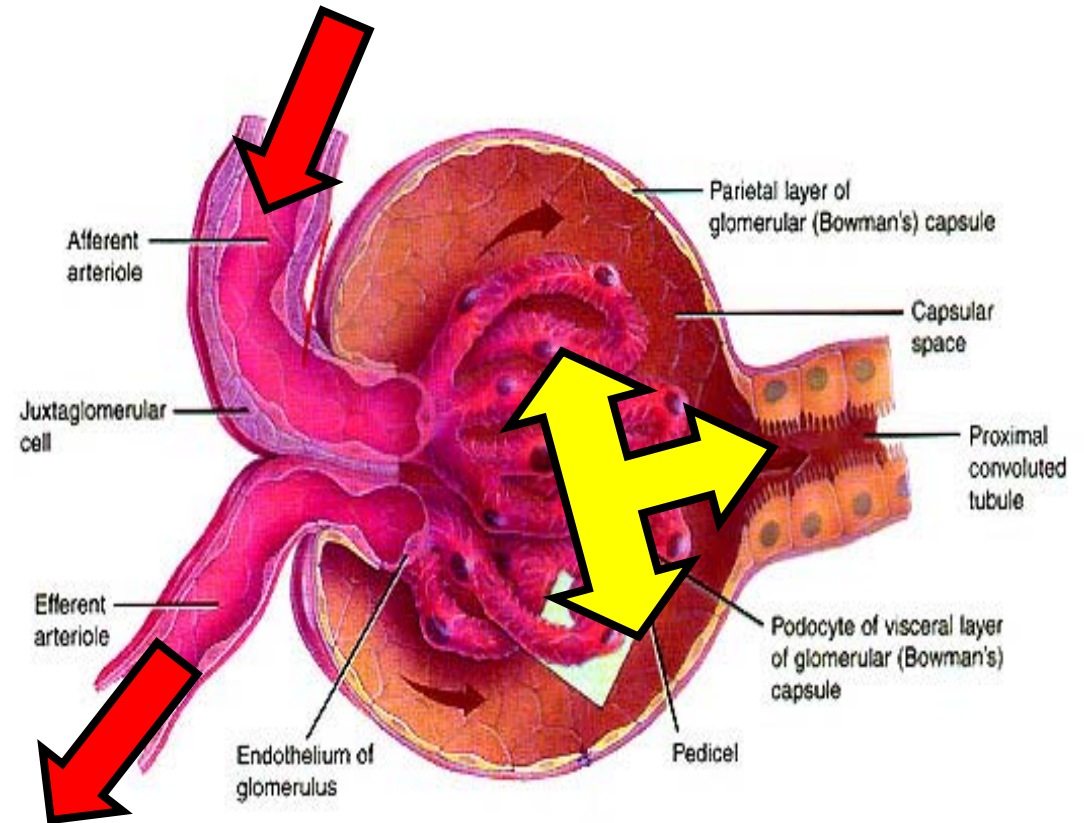
Kidney - Internal Micro Anatomy

- ~1 million nephrons are located in the cortex
- The filtrate is carried by the collecting duct system through the medulla
- The urine is collected at the papillae into the minor and major calyces



Nephron

- Renal corpuscle
 - Site of plasma filtration
 - 2 components
 - Glomerulus
 - tuft of capillary loops
 - fed by afferent arteriole
 - drained by efferent arteriole



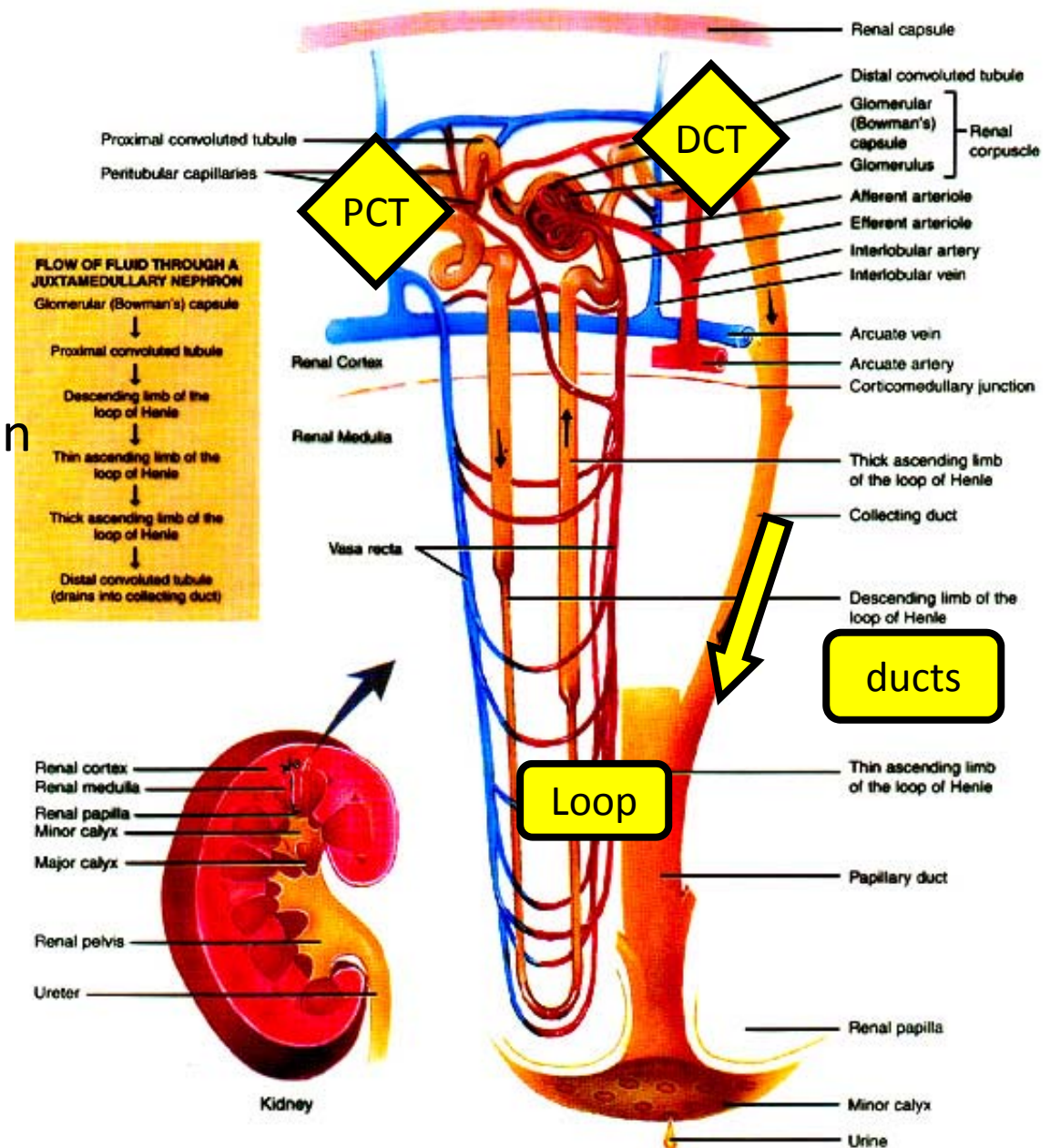
- Glomerular (Bowman's) capsule
 - double walled cup lined by simple squamous epithelium
 - outer wall (parietal layer) separated from inner wall (visceral layer = podocytes) by capsular (Bowman's) space

As blood flows through capillary tuft – filtration occurs

- water and most dissolved molecules pass into capsular space
- large proteins and formed elements in the blood do not cross

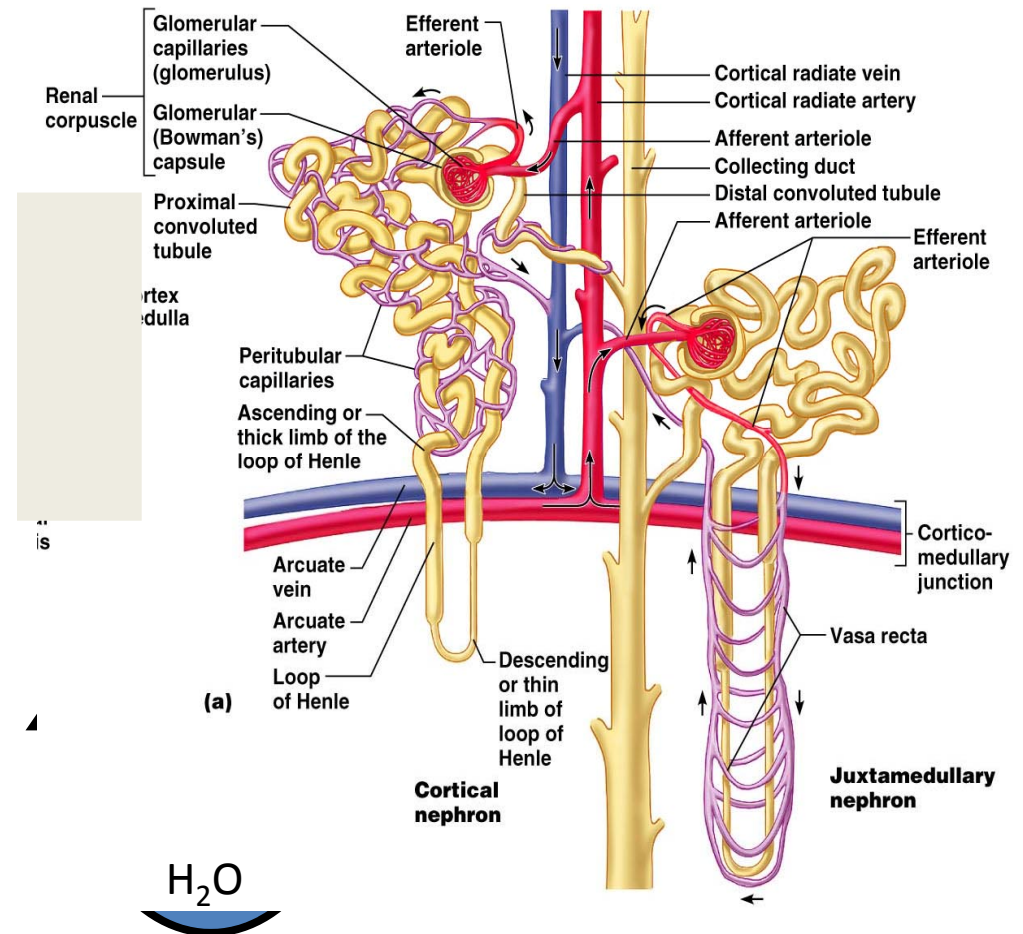
Nephron

- Renal tubule - where filtered fluid passes from capsule
 - Proximal convoluted tubule (PCT)
 - Loop of Henle (nephron loop)
 - Distal convoluted tubule (DCT)
 - Short connecting tubules
 - Collecting ducts
 - Papillary duct
 - then to minor calyx
 - 30 pap ducts/papillae



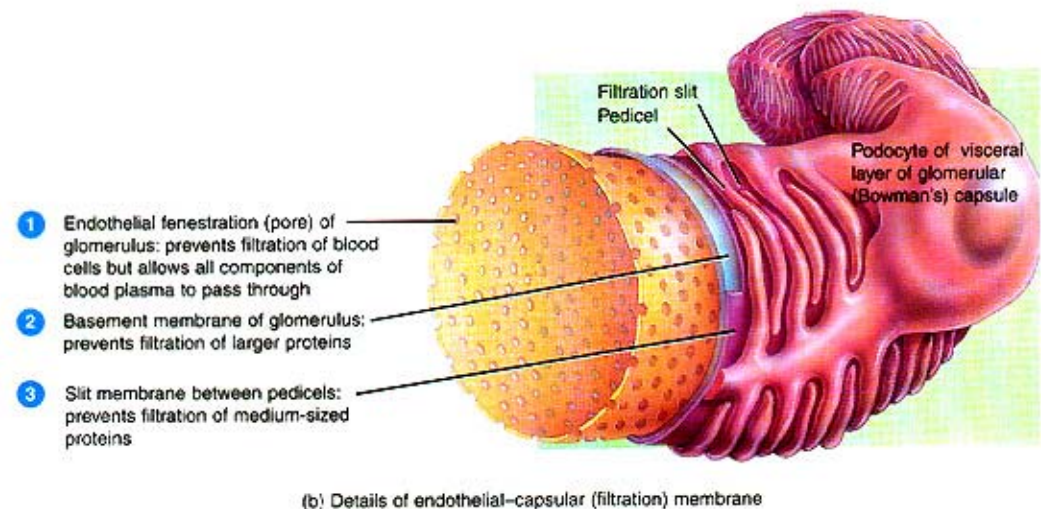
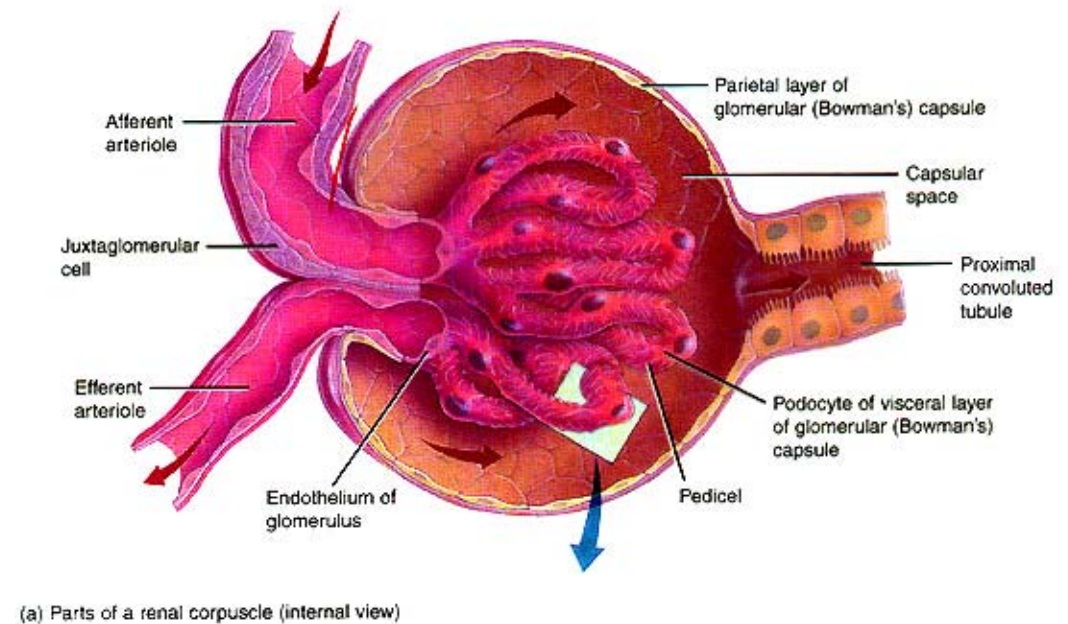
Nephron

- Cortical nephrons
 - 80-85% of nephrons
 - Short loops
- Juxtamedullary nephrons
 - 15-20% of nephrons
 - Longer loops and increased involvement in the reabsorption of water
- Each portion of the nephron has distinctive features

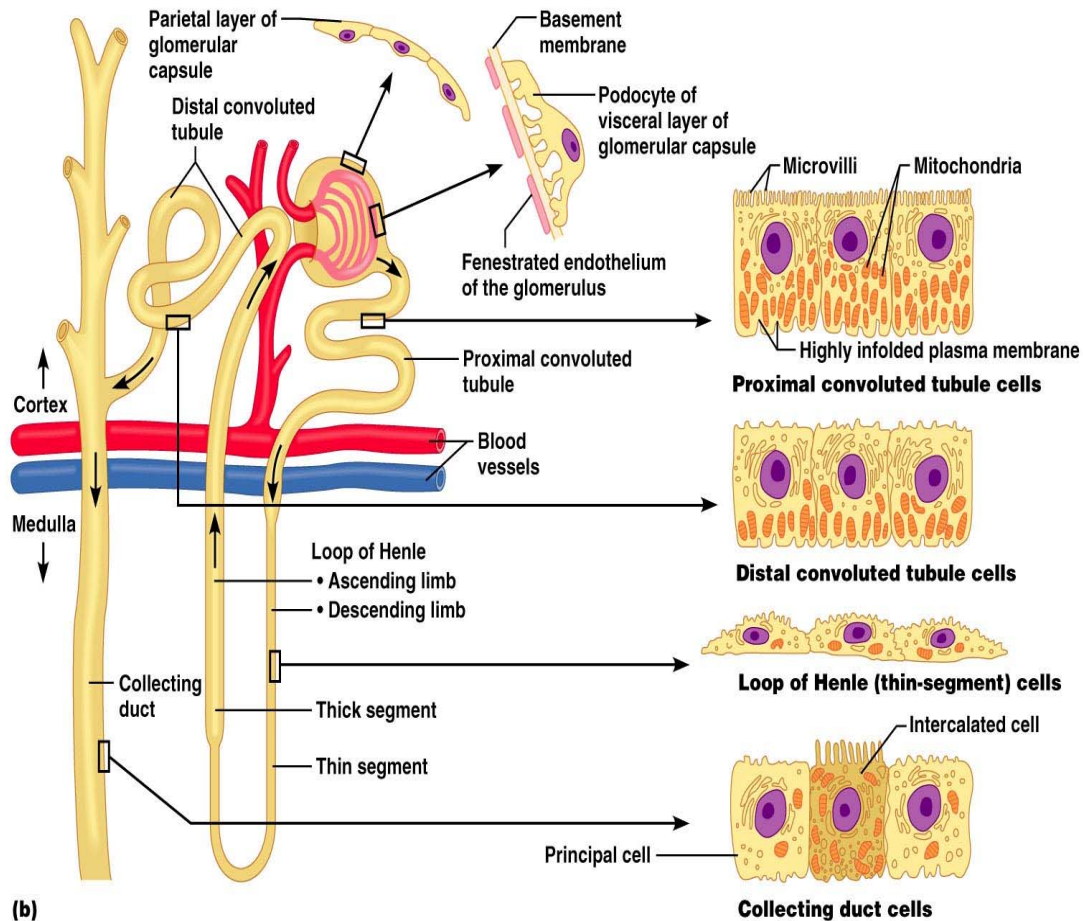


Renal Corpuscle Histology

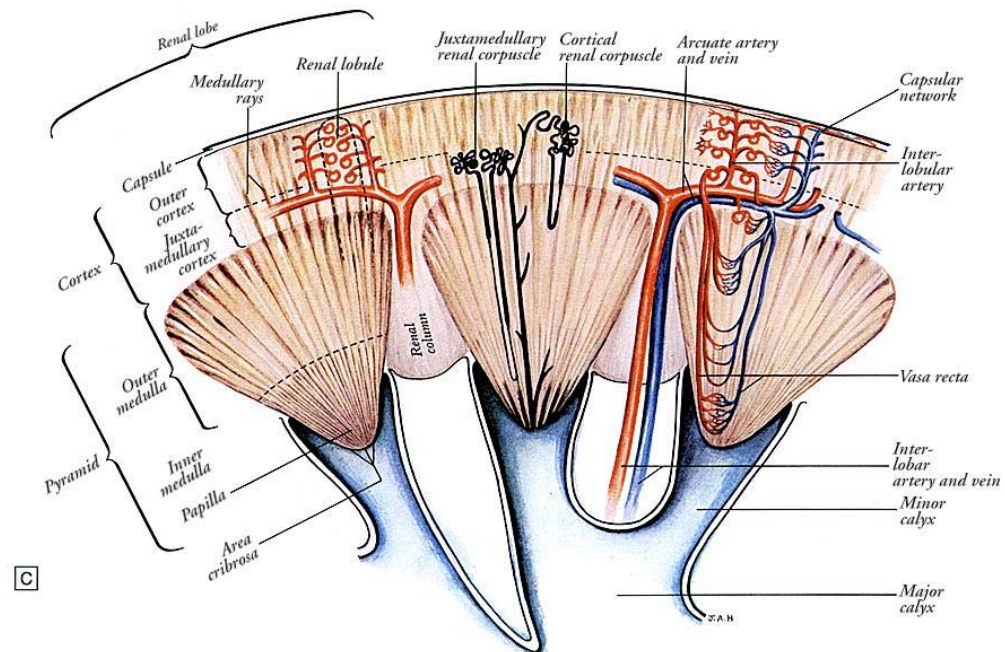
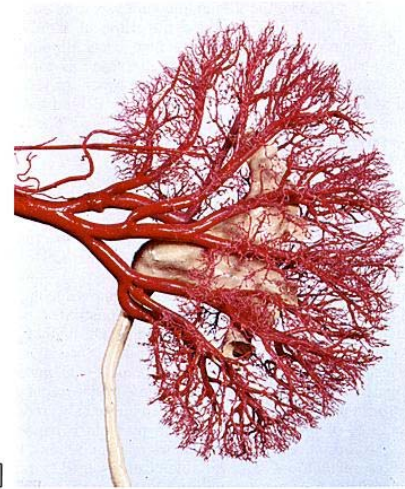
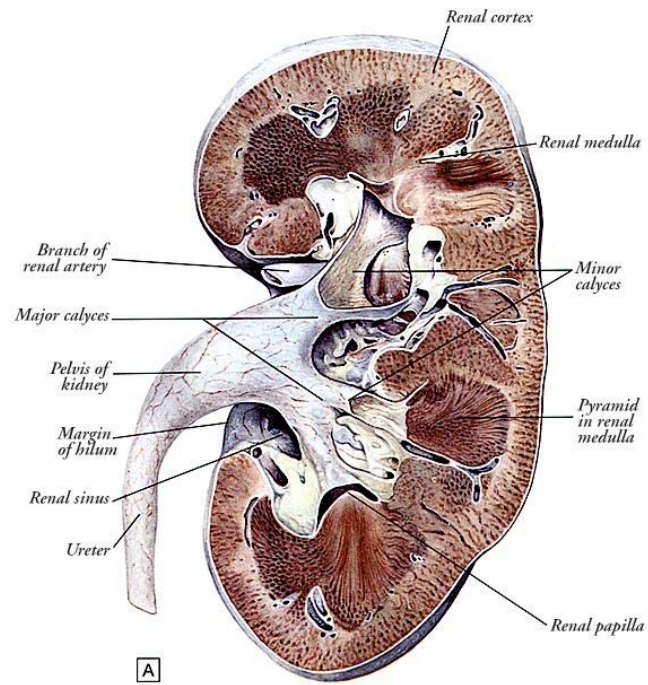
- The glomerular filtration unit
 - Three components to the filter
 - From inside to out, the layers prevent movement of progressively smaller particles

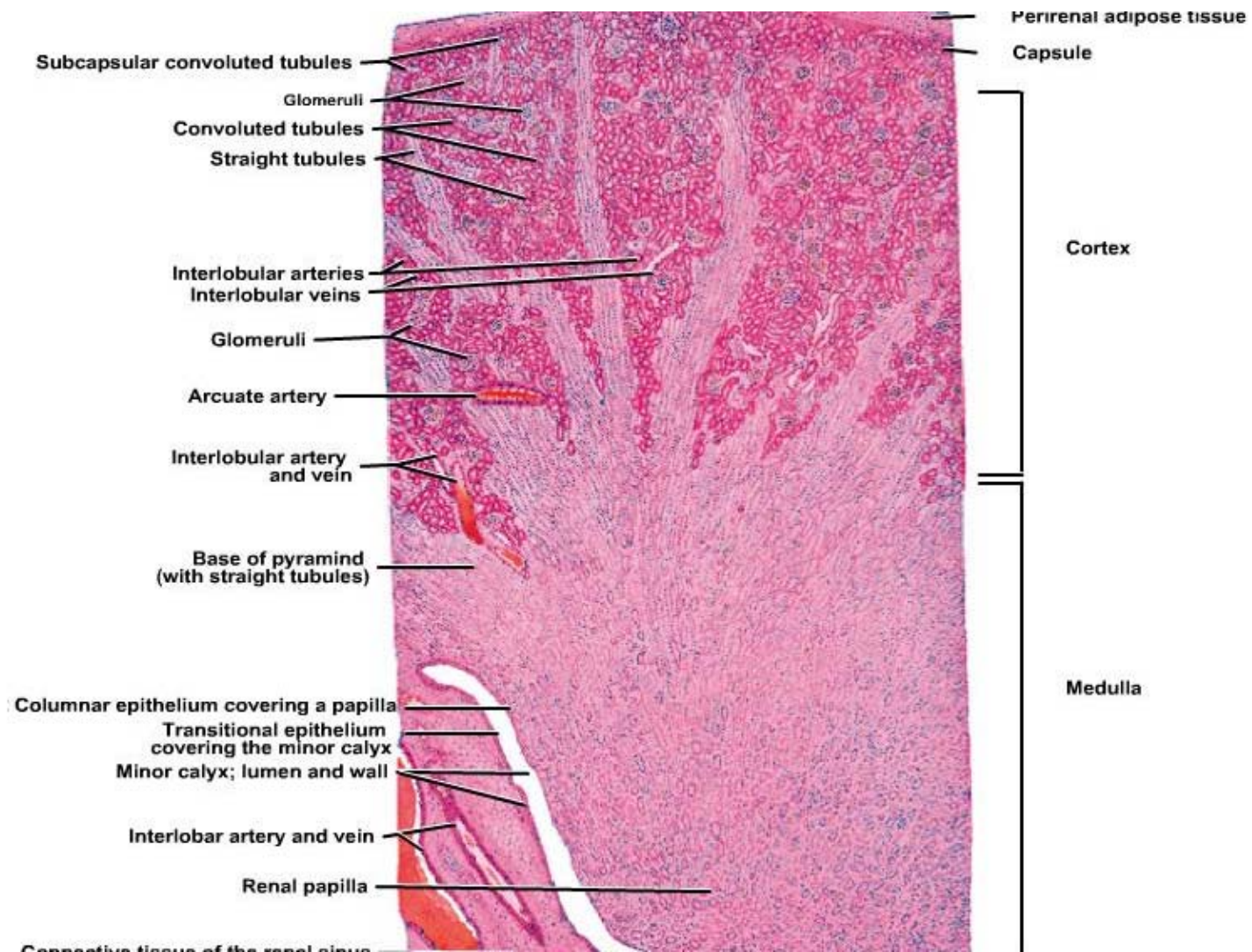


Tubule Histology

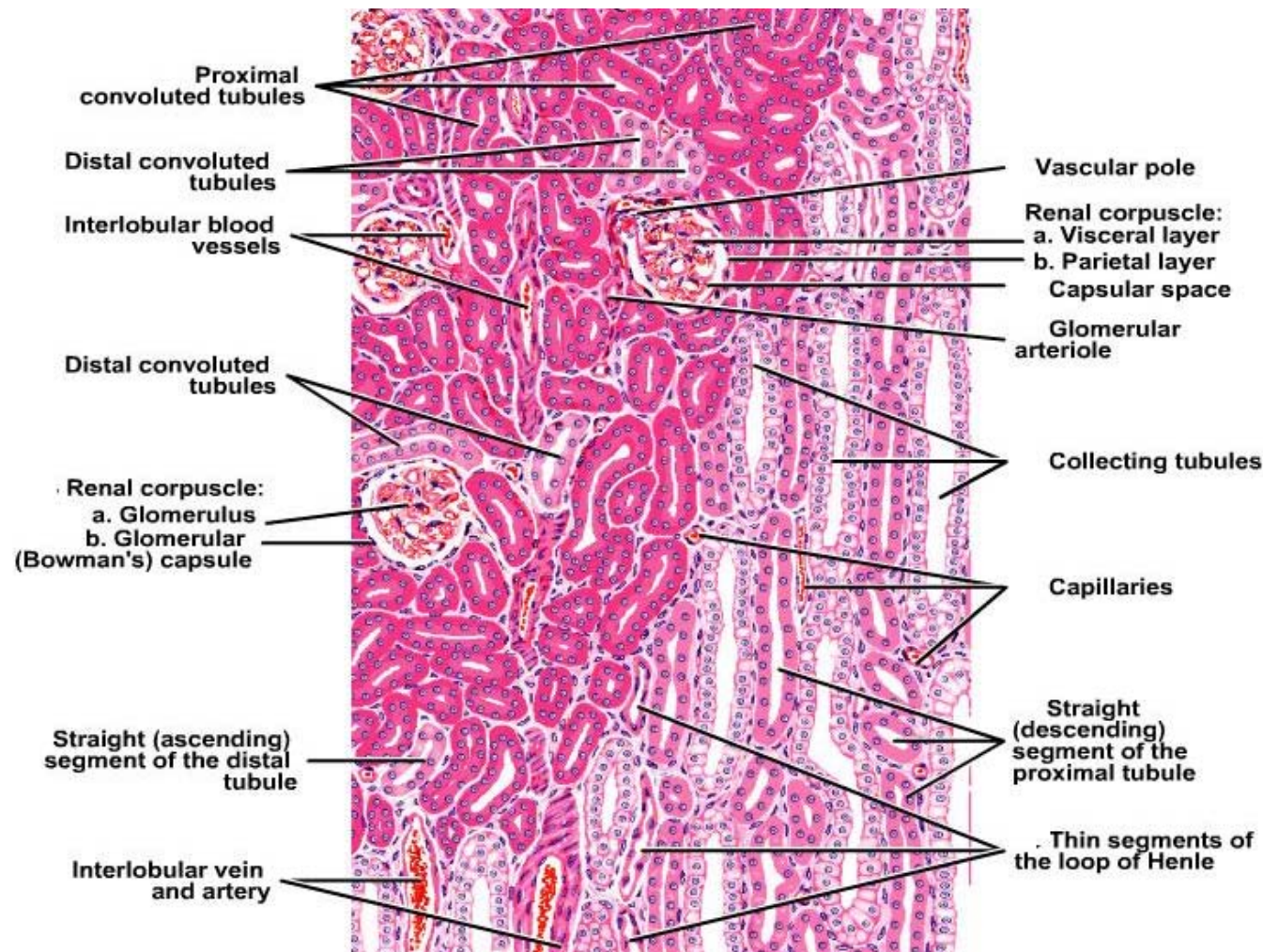


- PCT - cuboidal cells with apical microvilli
- Descending loop, and beginning of ascending loop
 - simple squamous epithelium
 - water permeable
- Remainder of ascending limb of the loop
 - cuboidal to low columnar epithelial cells
 - impermeable to water
 - permeable to solute (ions)
- DCT, collecting ducts
 - cuboidal with specialized cells
 - principal cells - sensitive to ADH (antidiuretic hormone)
 - intercalated cells - secrete H^+



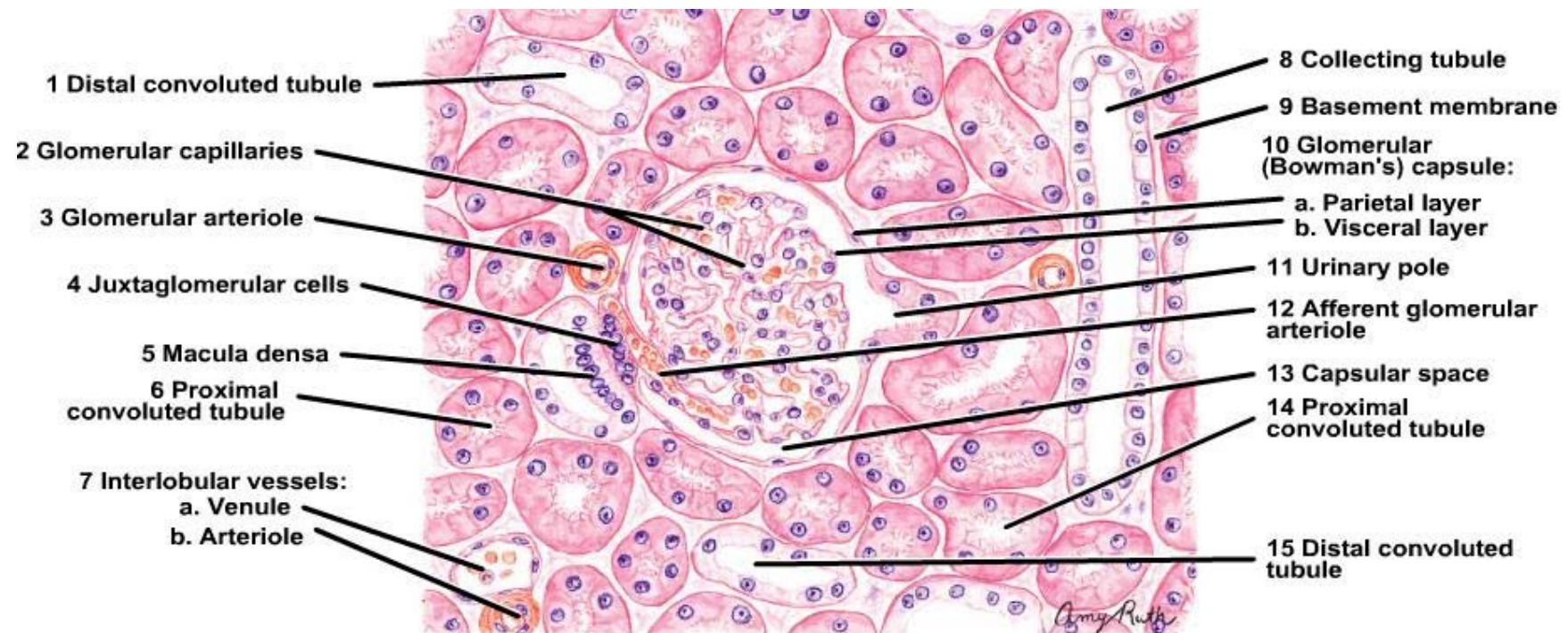


KIDNEY : CORTEX AND ONE PYRAMID

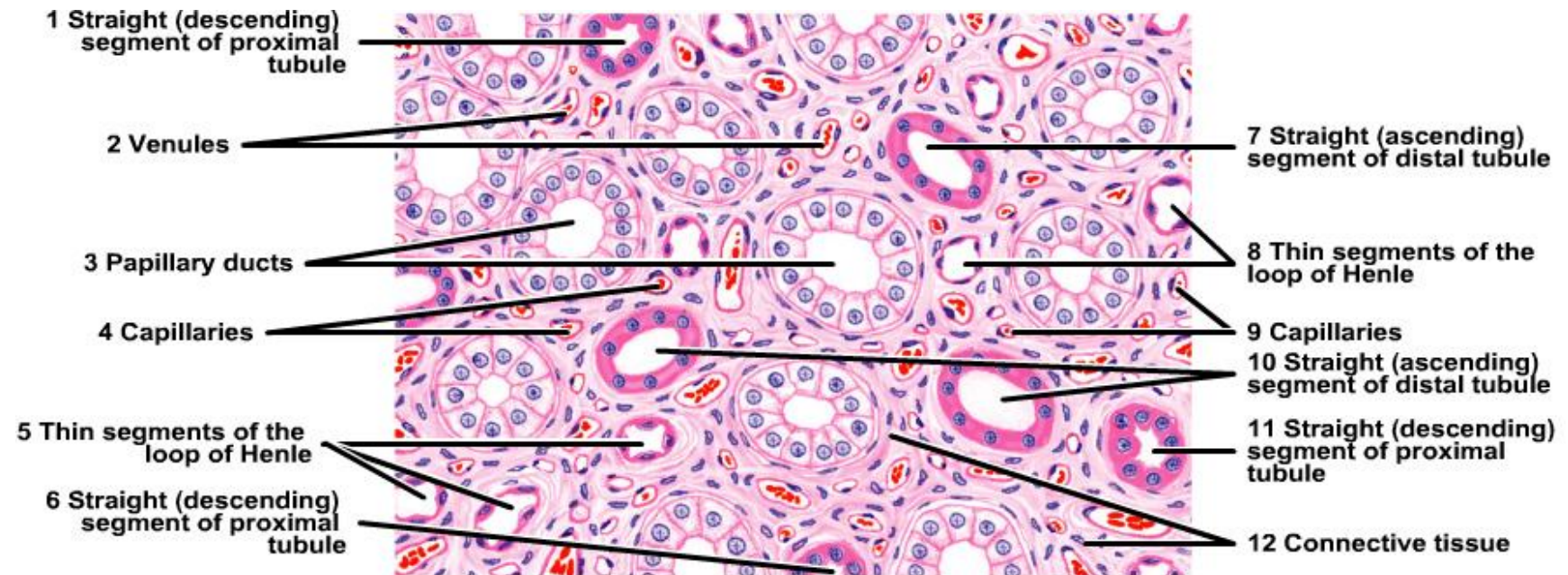


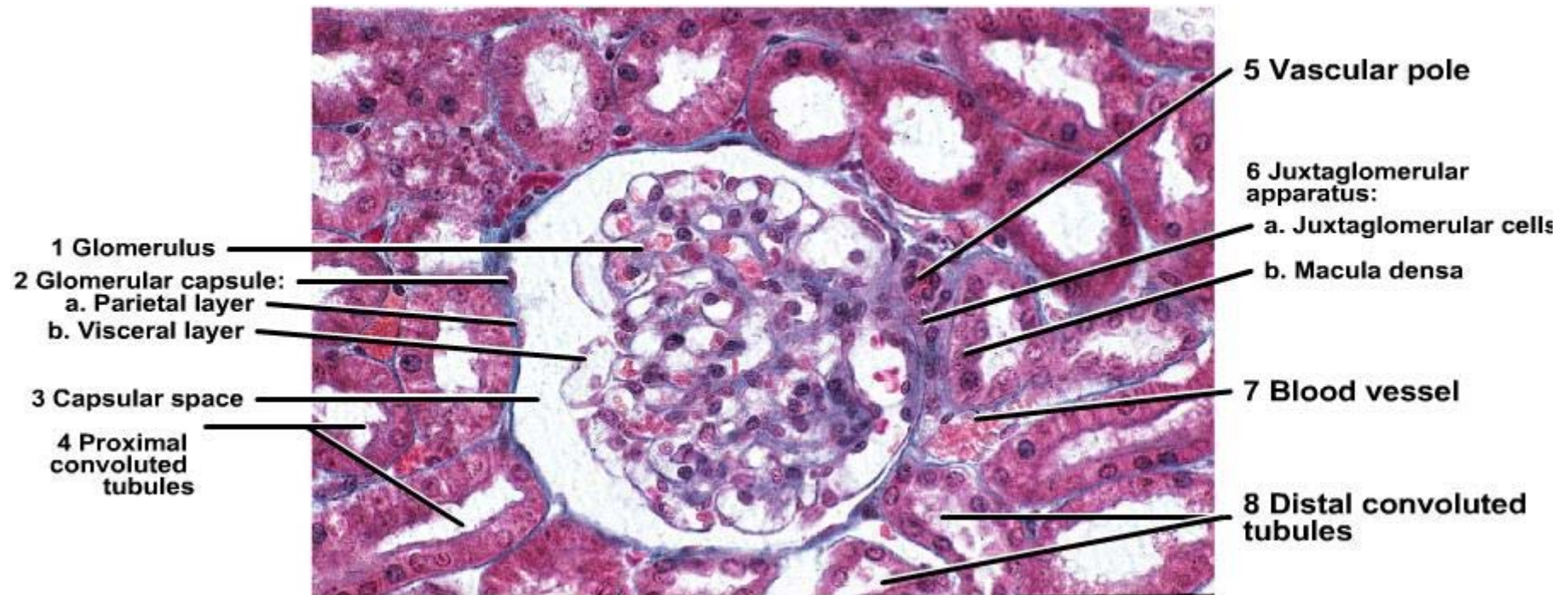
DEEP CORTICAL AREA AND OUTER MEDULLA

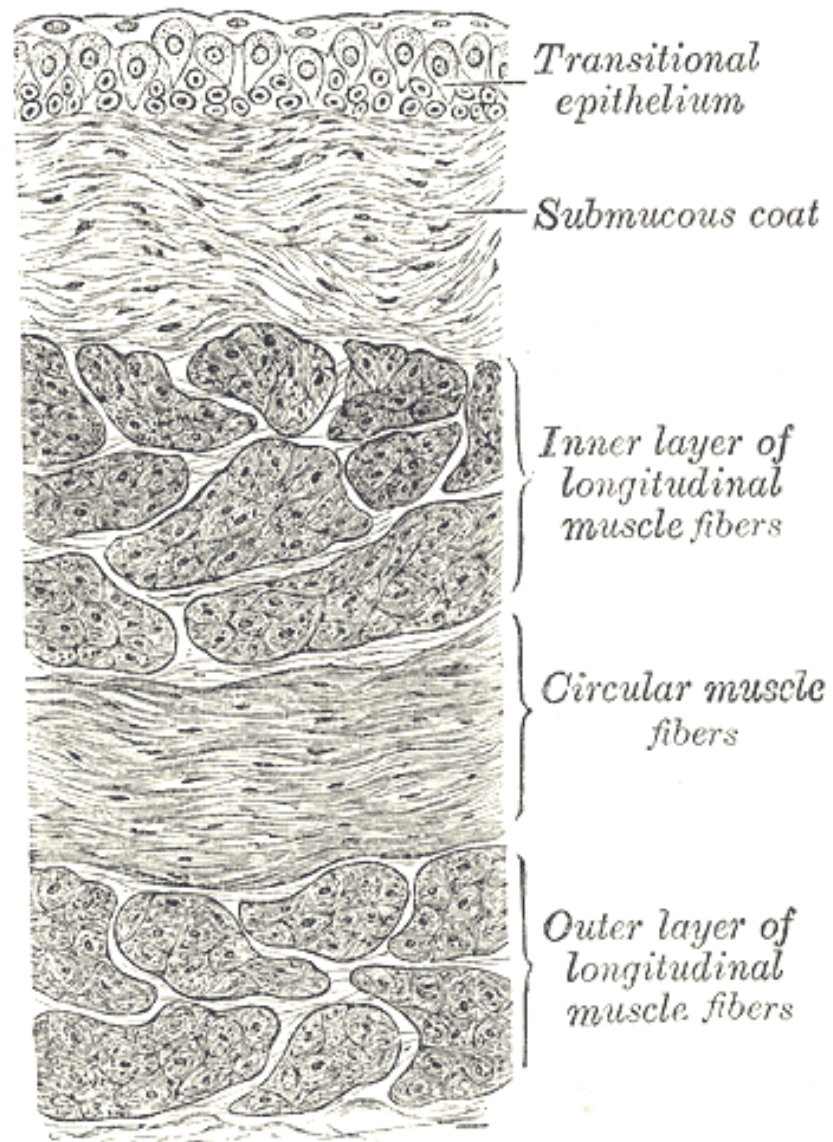
KIDNEY CORTEX : THE JUXTAGLOMERULAR APPARATUS



PAPILLA (TS)







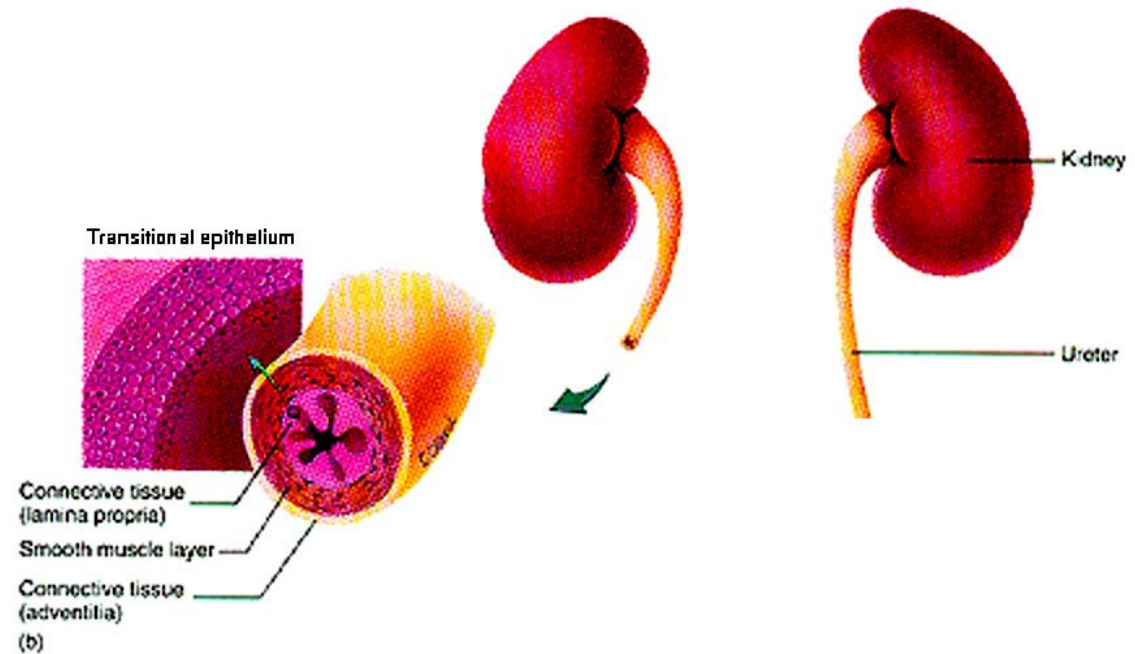
- Ureters

- extensions of the renal pelvis

- enter the bladder medially from the posterior

- transport urine to the bladder

- peristalsis primarily, but hydrostatic pressure of gravity helps in humans

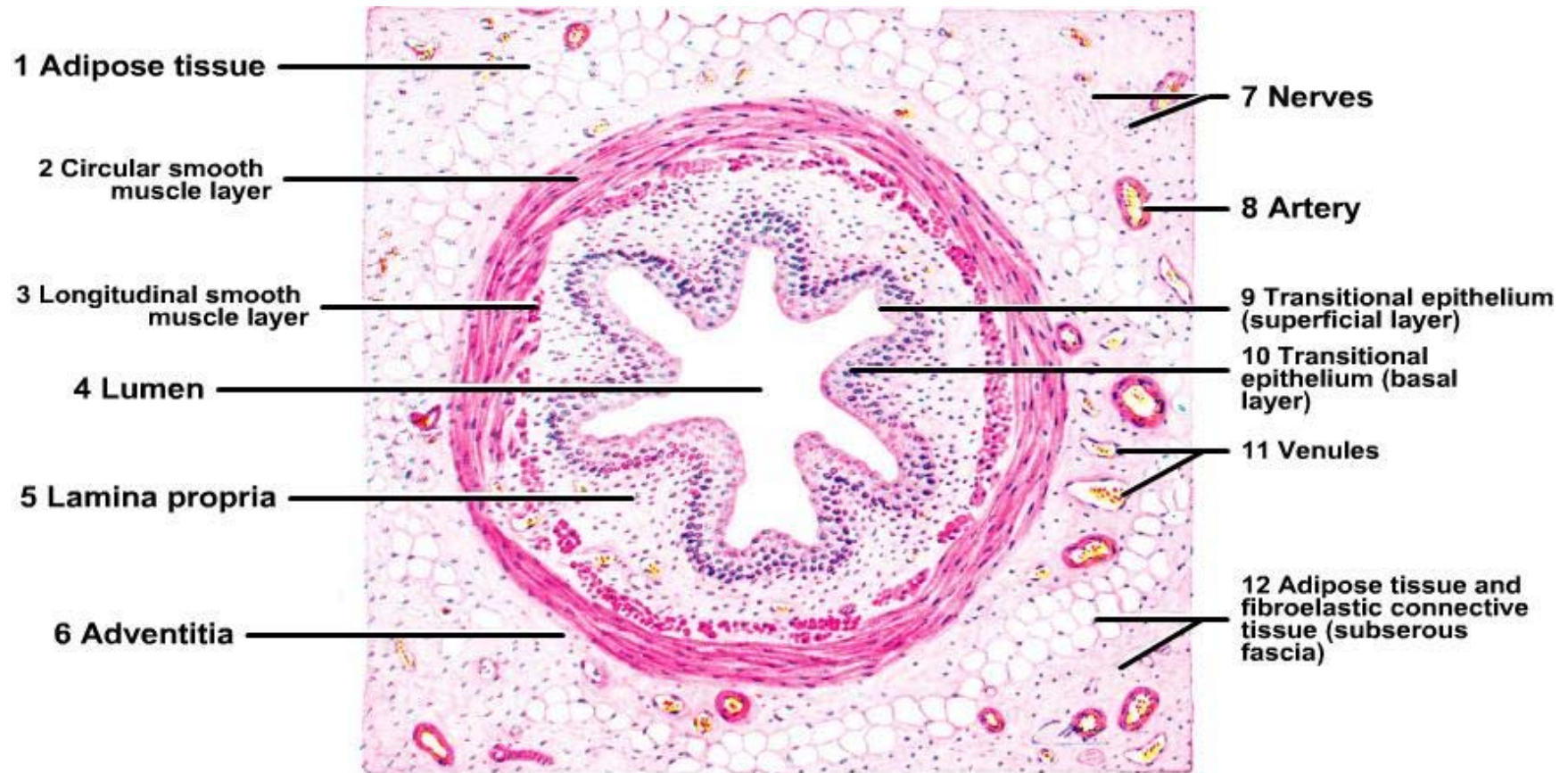


Ureter

- Stellate lumen
- 3 layers of smooth muscle
 - Inner = longitudinal
 - middle = circular
 - Outer = longitudinal
- Peristalsis contribute to urine flow

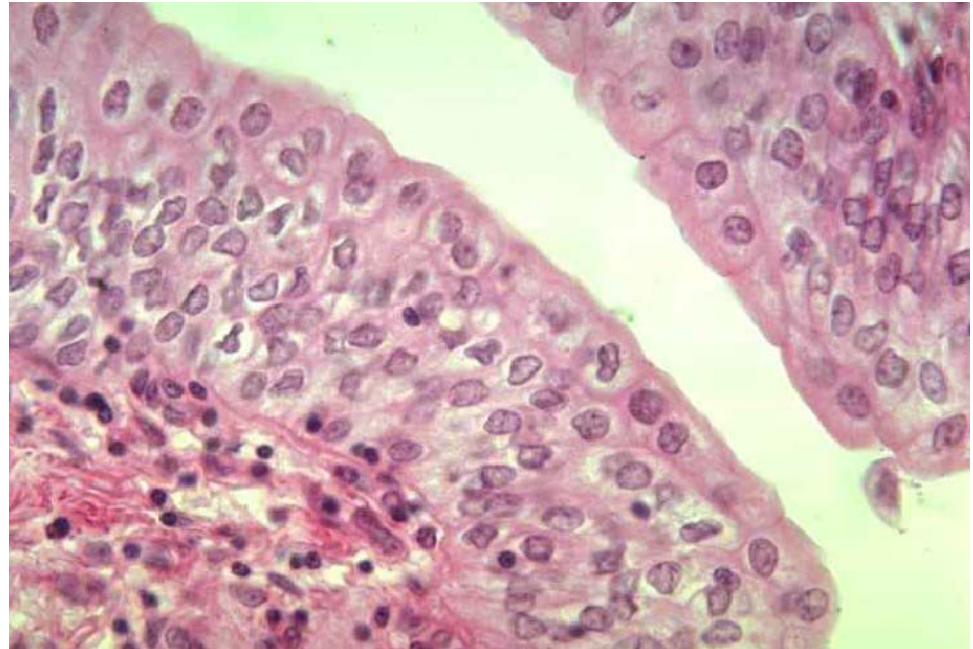


URETER (TS)



Transitional Epithelium

- Lines the ureter and bladder
- Allows for changes in volume
- Impermeable to salt and water
- Look for:
 - Dome-shaped, bulging
 - Eosinophilic
 - Flatten as bladder distends

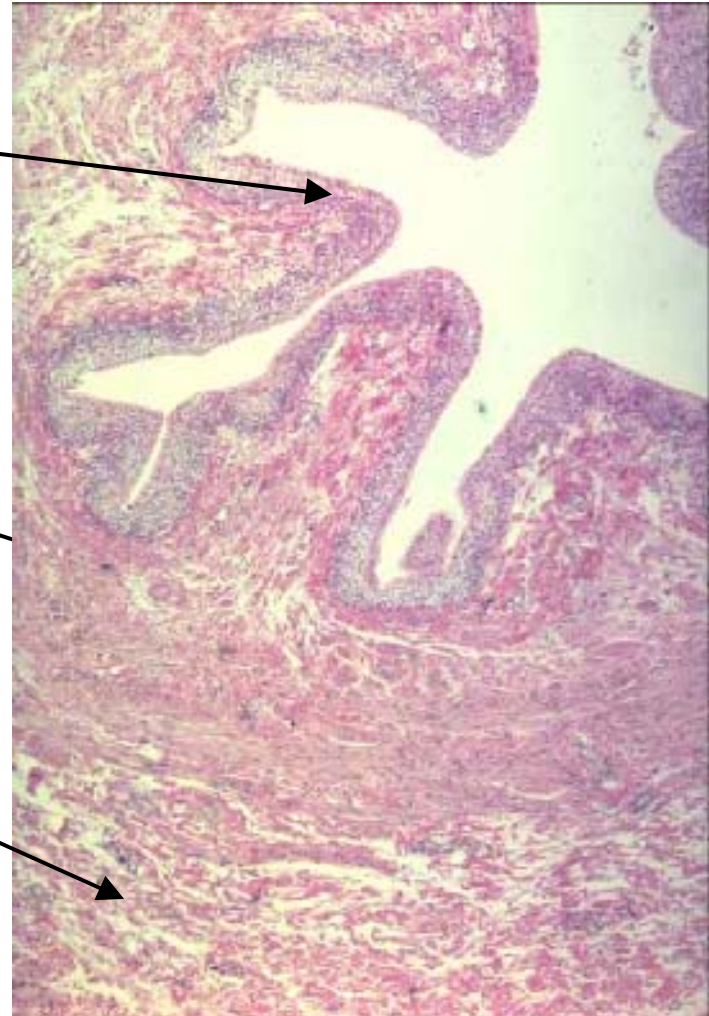


Ureter

- Transitional Epithelium

- Muscularis
 - 2 or more layers

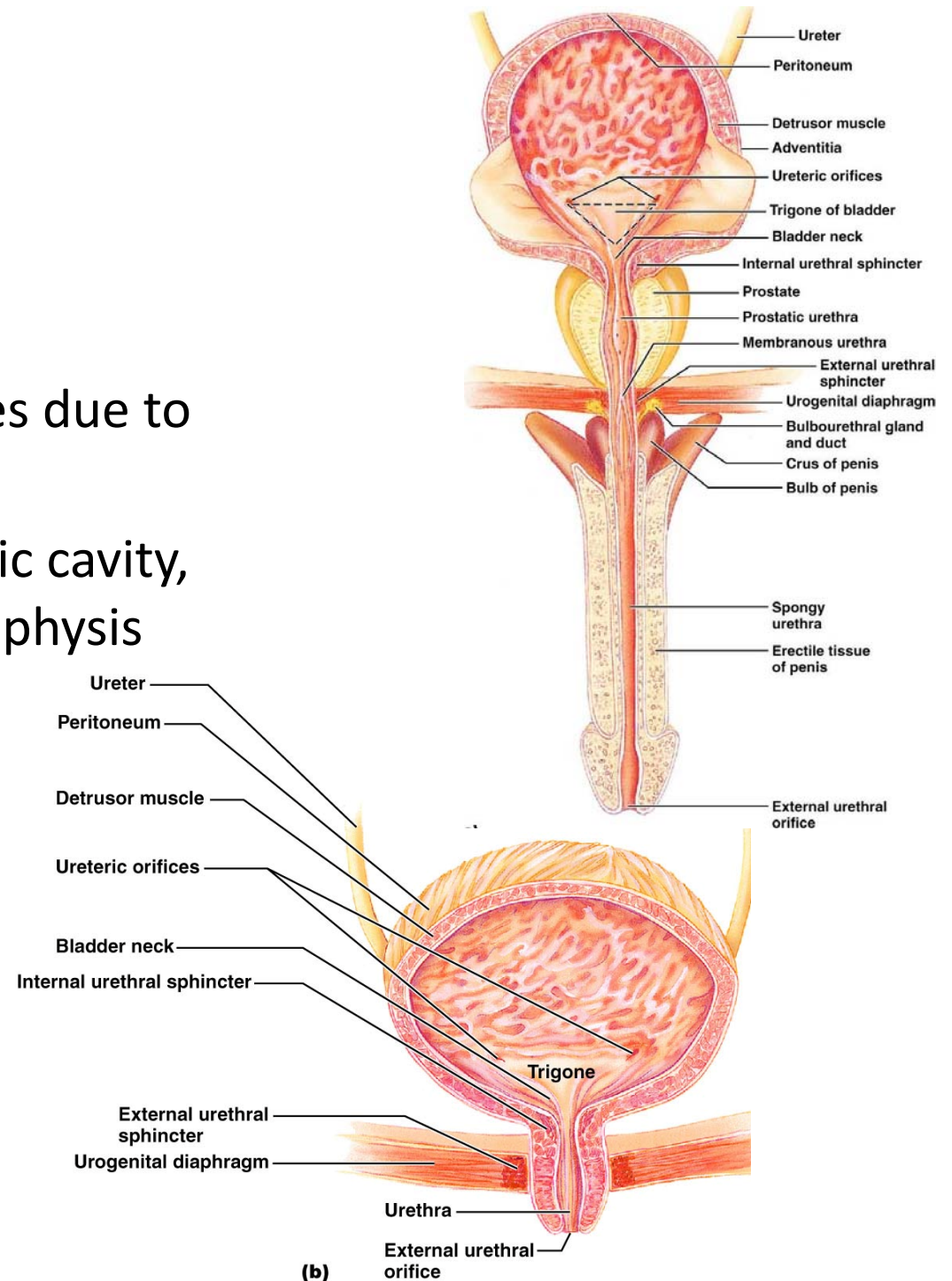
- Adventitia
 - Contain fat, vessels, nerves

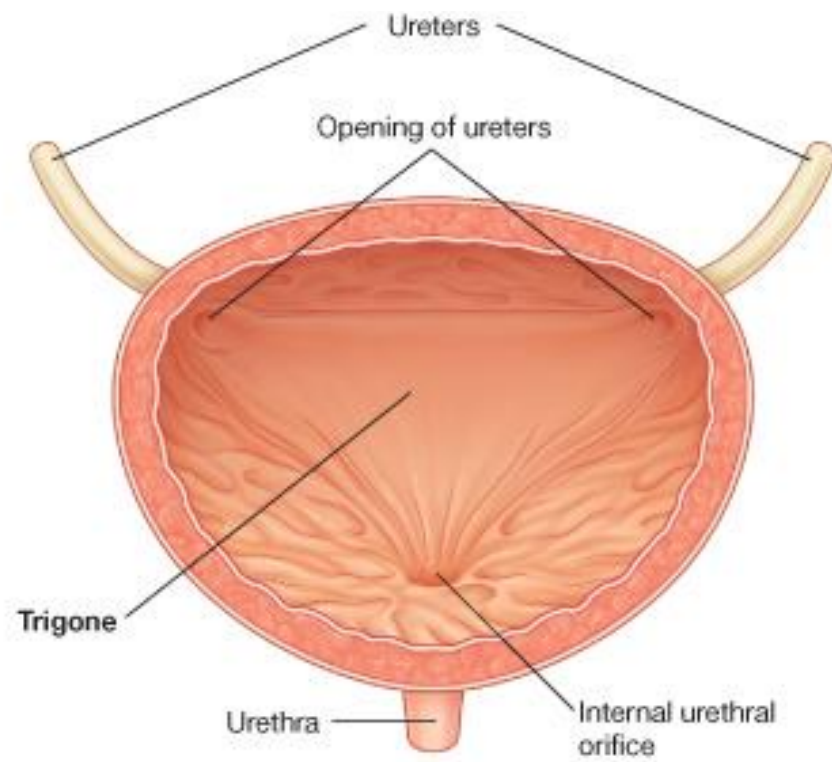


A SECTOR OF THE WALL

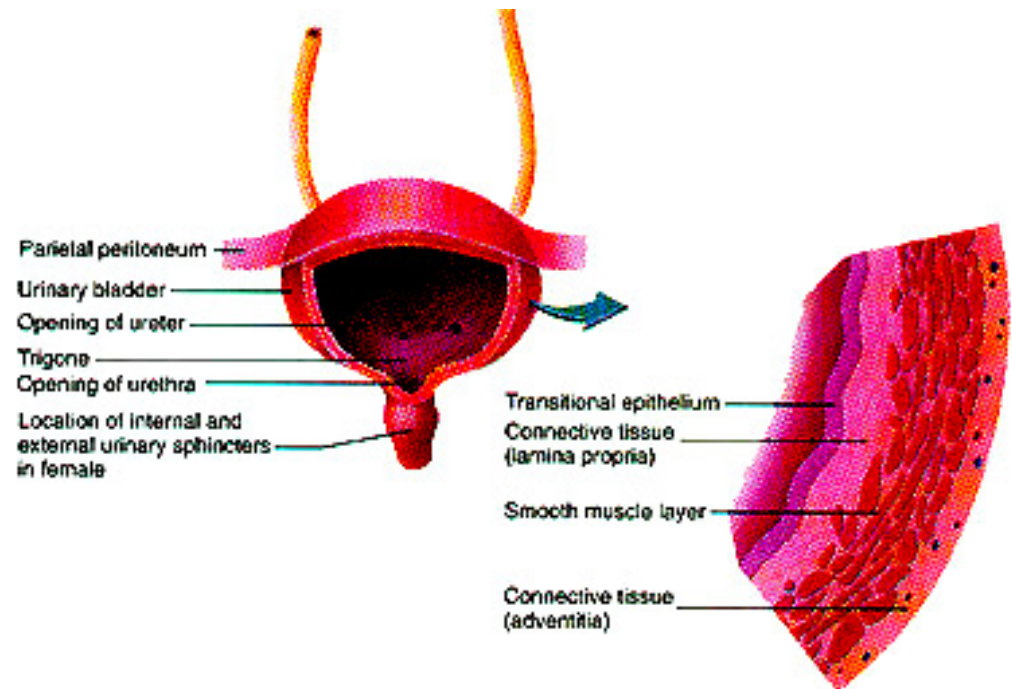


- Urinary bladder
 - hollow muscular organ
 - generally smaller in females due to presence of a uterus
 - retroperitoneal in the pelvic cavity, posterior to the pelvic symphysis
 - freely movable
- Structure - trigone



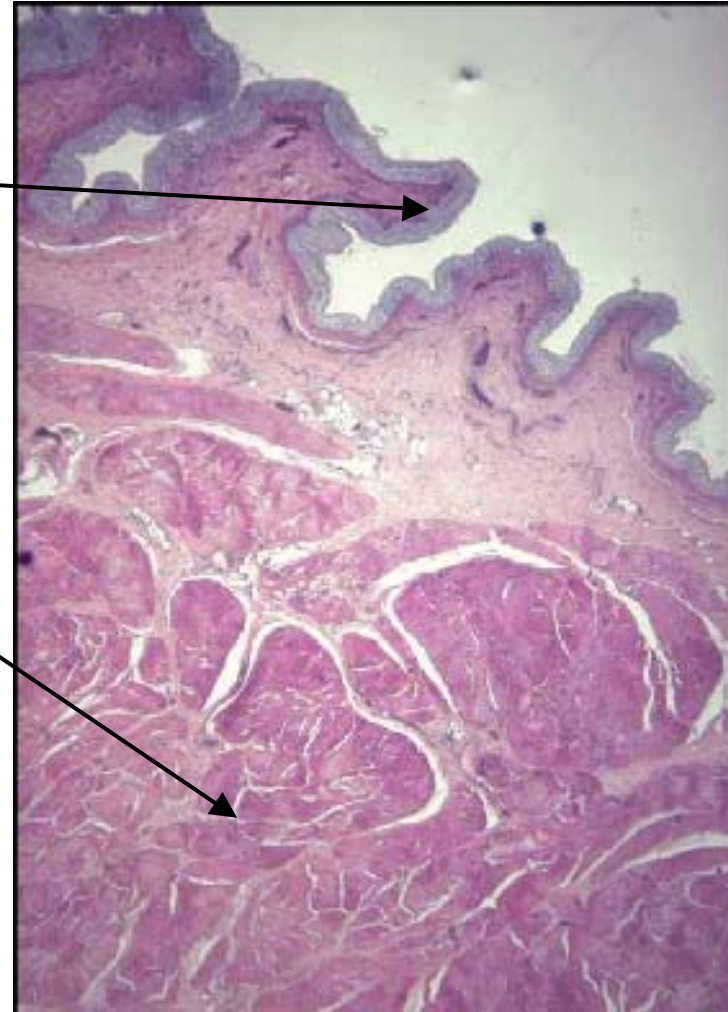


- Bladder histology
 - inner mucosa lined with transitional epithelium
 - muscularis – smooth muscle in three layers
 - Sphincters control entry from ureters and exit at the urethra
 - circular smooth muscle fibers form internal urethral sphincter
 - lower is the external urethral sphincter with skeletal muscle for voluntary control
 - retroperitoneal (serosa or adventitia)



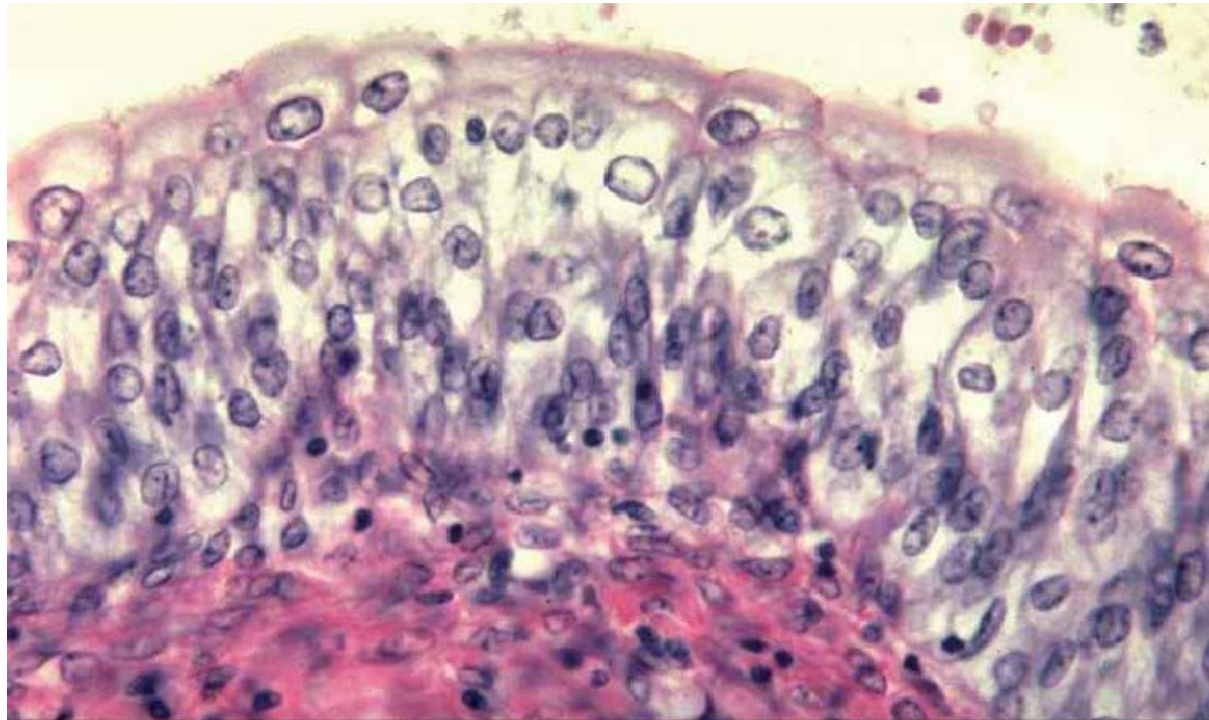
Bladder

- Transitional epithelium
- Smooth muscle in various planes
 - Allow for contraction in all directions

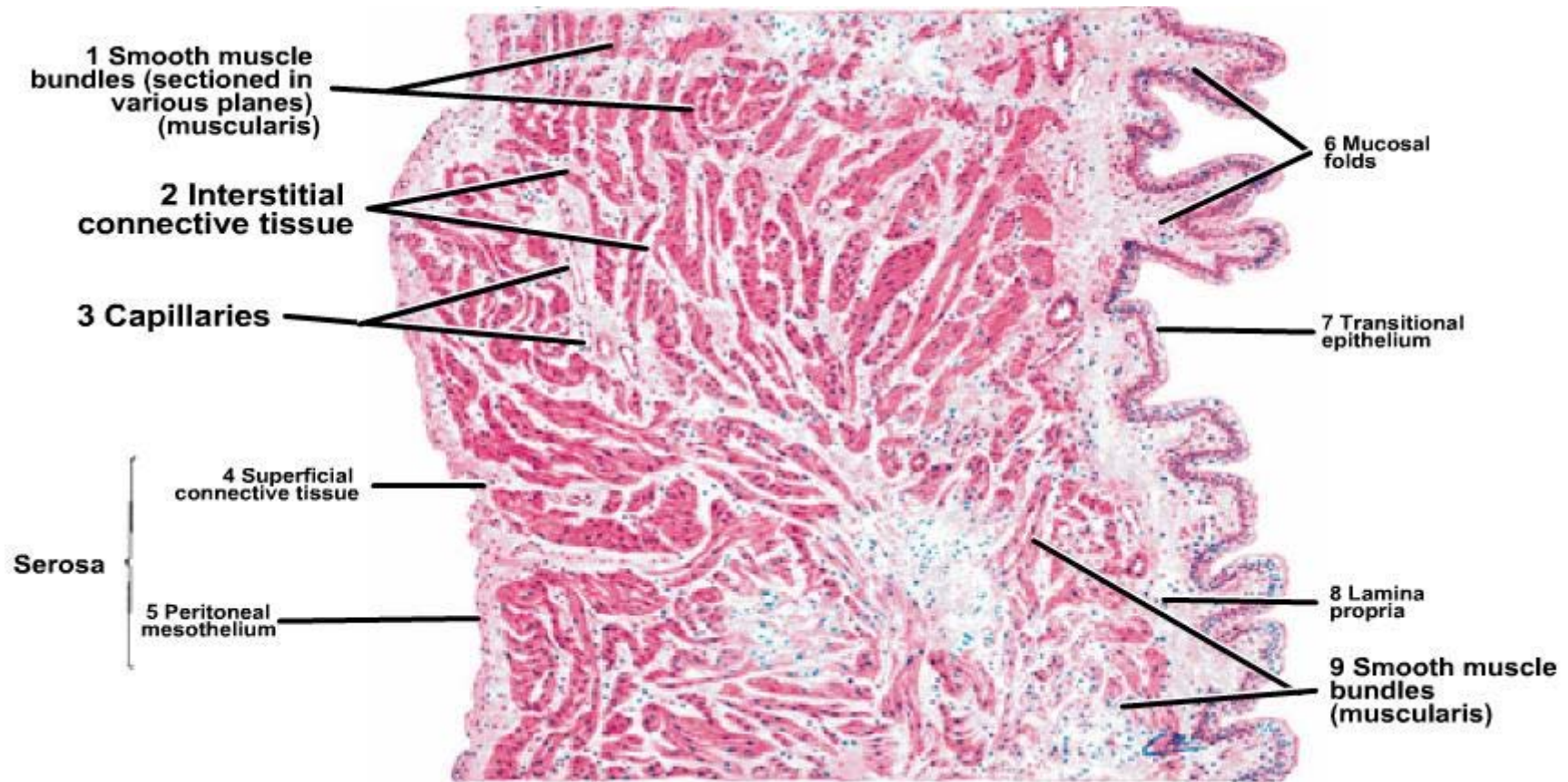


Bladder

- Transitional Epithelium (Relaxed State)
- Darkly eosinophilic due to invaginated plaques



URINARY BLADDER (WALL : TS)



URINARY BLADDER (MUCOSA : TS)

