RENAL FUNCTION

นพ.สมพล บูรณะโอสถ

Functions of the Kidneys

- **Regulation** of blood volume: …
- **Regulation** of blood pressure: …
- **Regulation** of the pH of the blood: …
- **Regulation** of the ionic composition of blood: …
- **Production** of Red blood cells: …
- **Synthesis** of Vitamin D: …
- **Excretion** of waste products and foreign substances:

A WET BED

- A maintaining acid-base balance
- W maintaining water balance
- E electrolyte balance
- T toxin removal
- B blood pressure control
- E making erythropoietin
- D vitamin D metabolism

fin

Anatomy/Function of the Kidney

Structure/Function

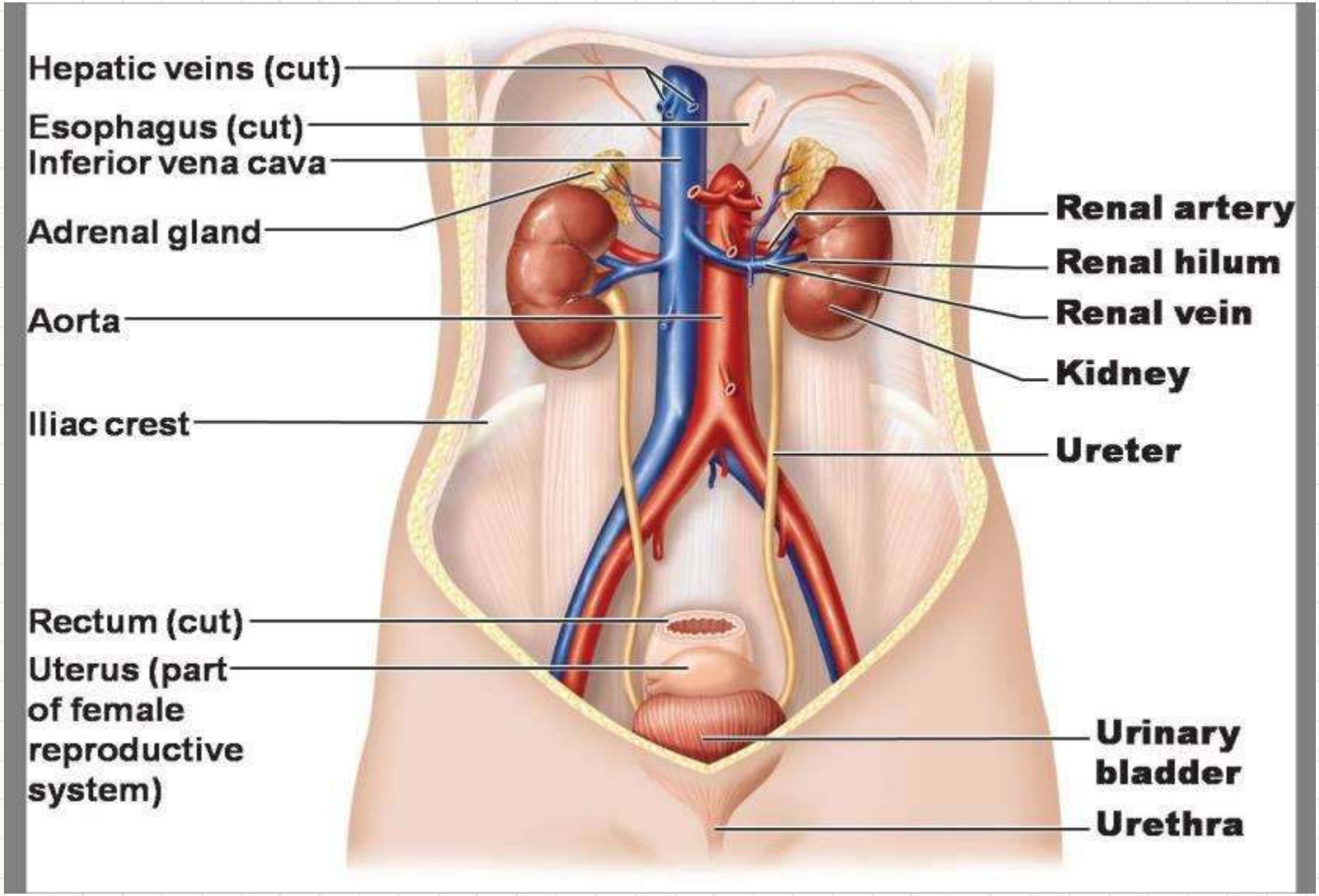
– 1% of body mass

– 25% of cardiac output passes total blood volume every 4-5 minutes

– Filters 180 l per day and reabsorbs 178.5 l of it

– Produces 1.5 l of acidic (pH~6) urine per day

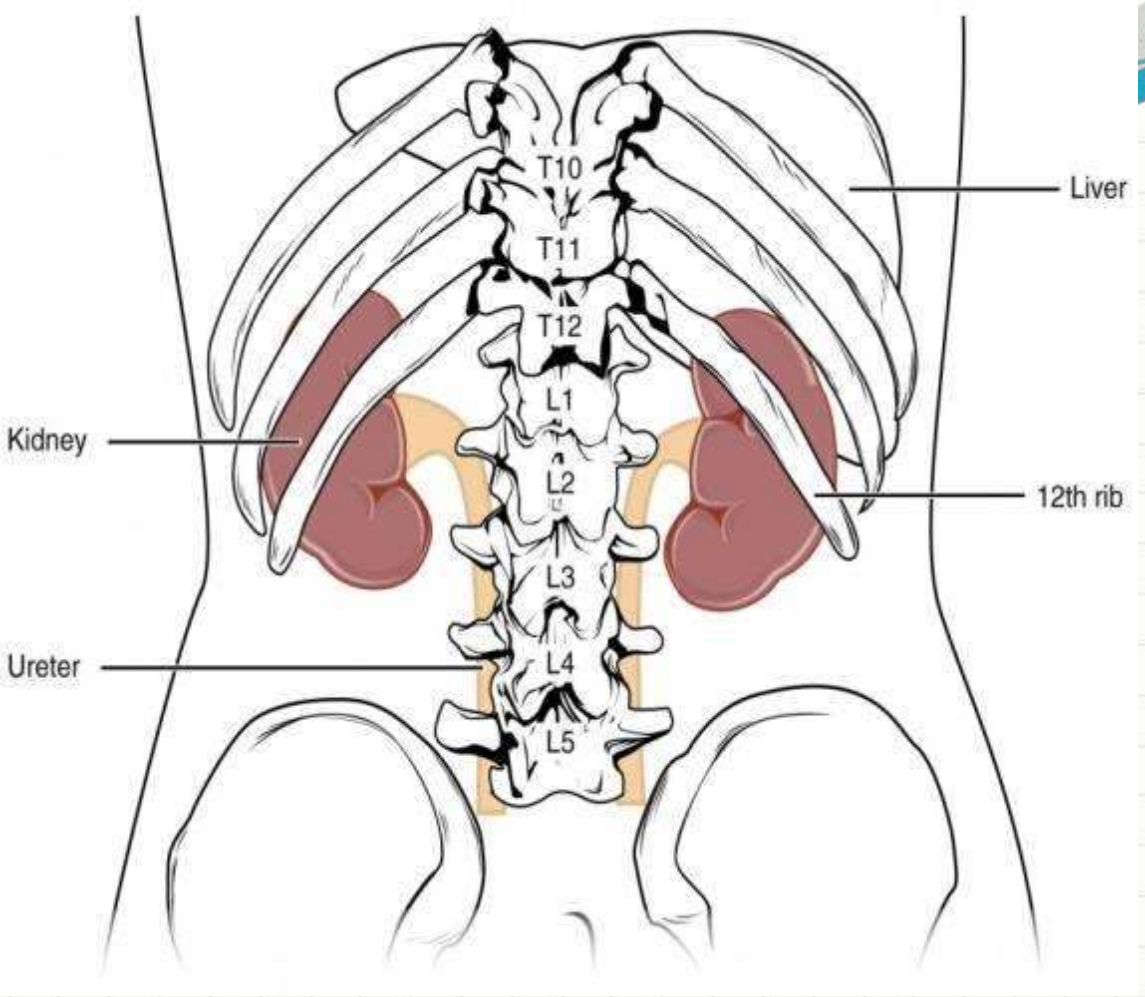
Kidney anatomy



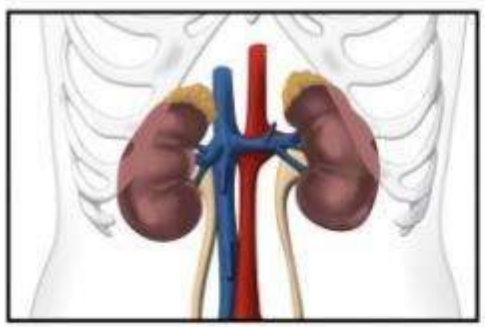
A retroperitoneal organ

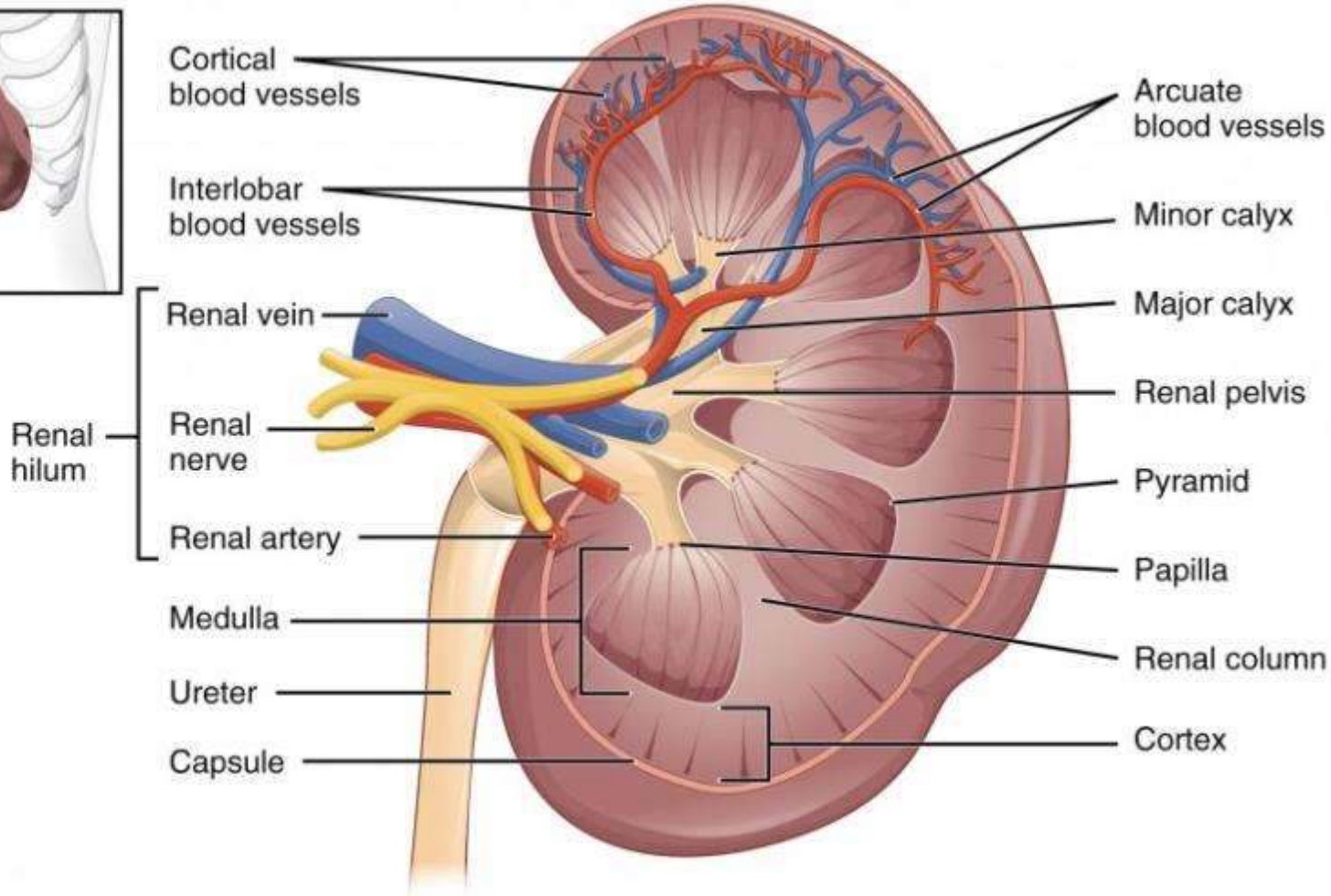
T11 –L3

Normal size 11-15 cm

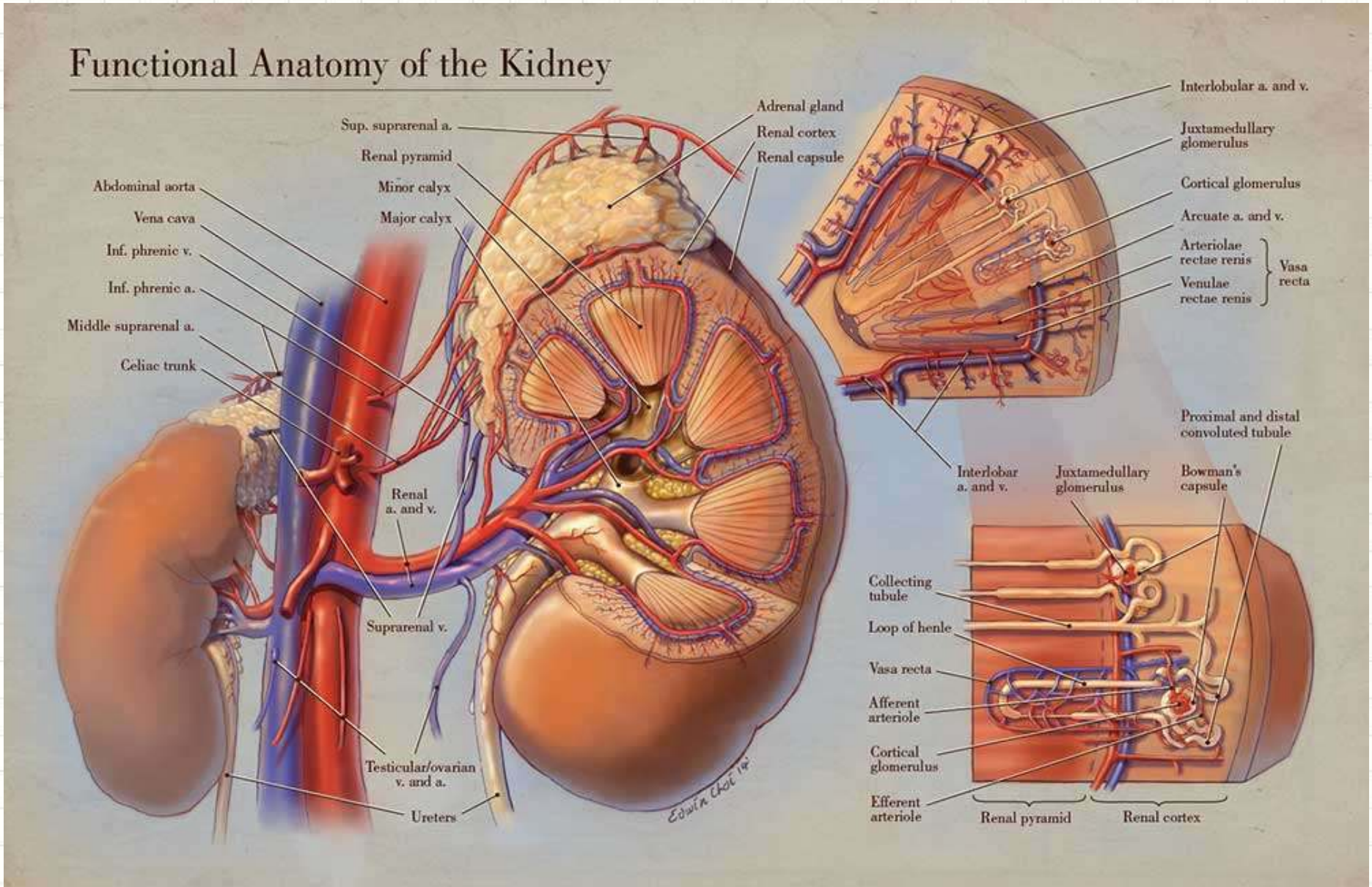


Anatomy/Function of the Kidney

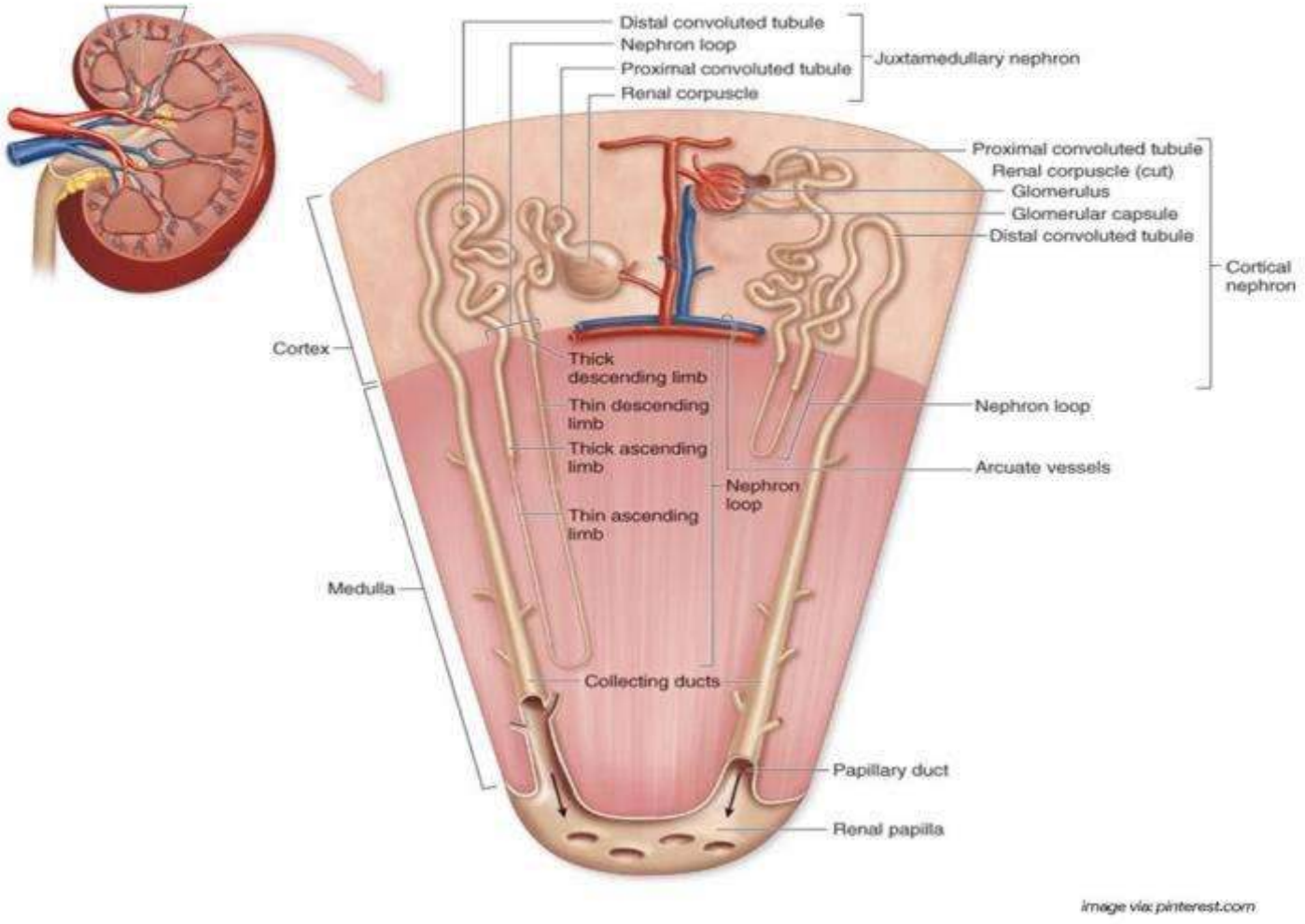


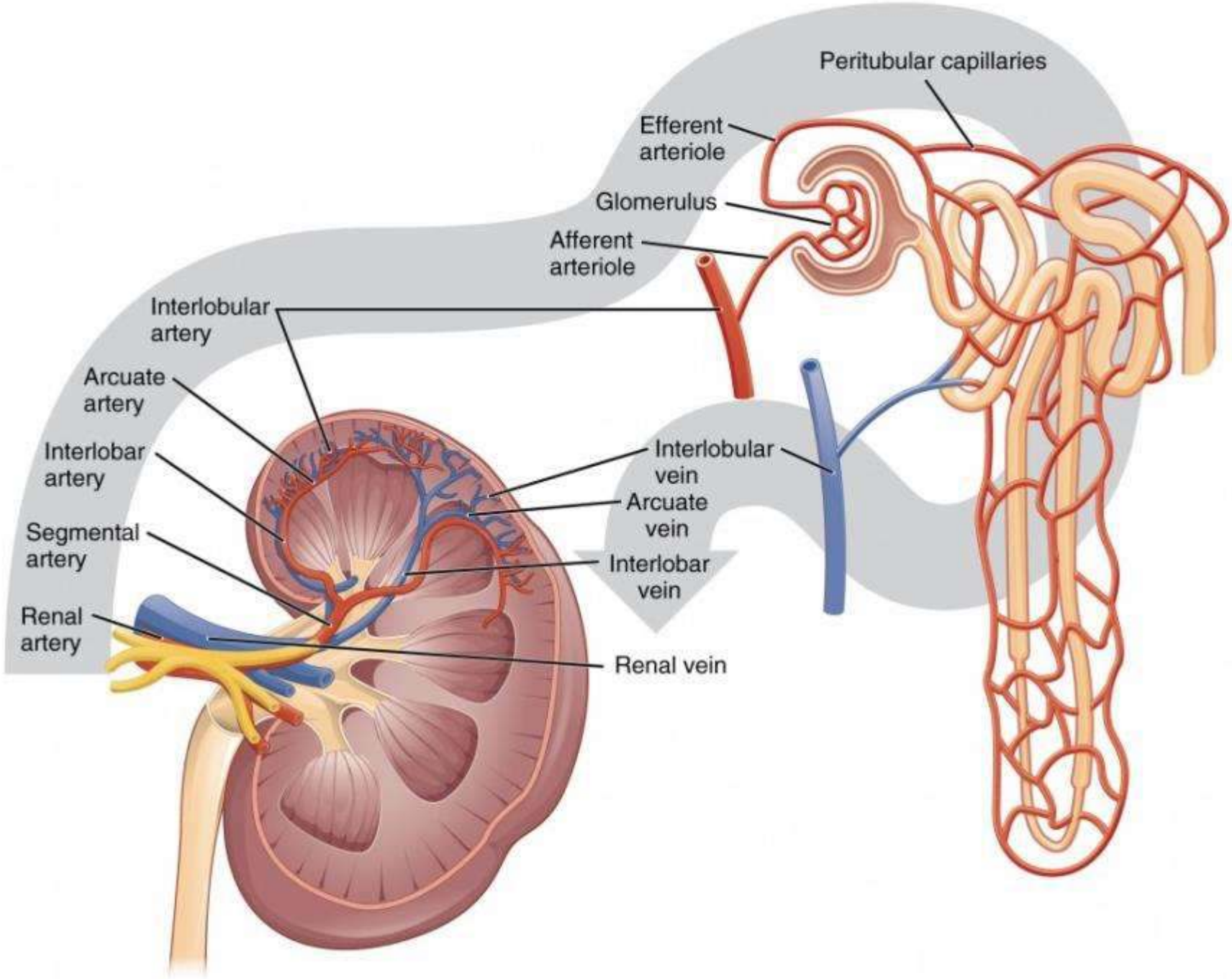


Anatomy/Function of the Kidney



Nephron

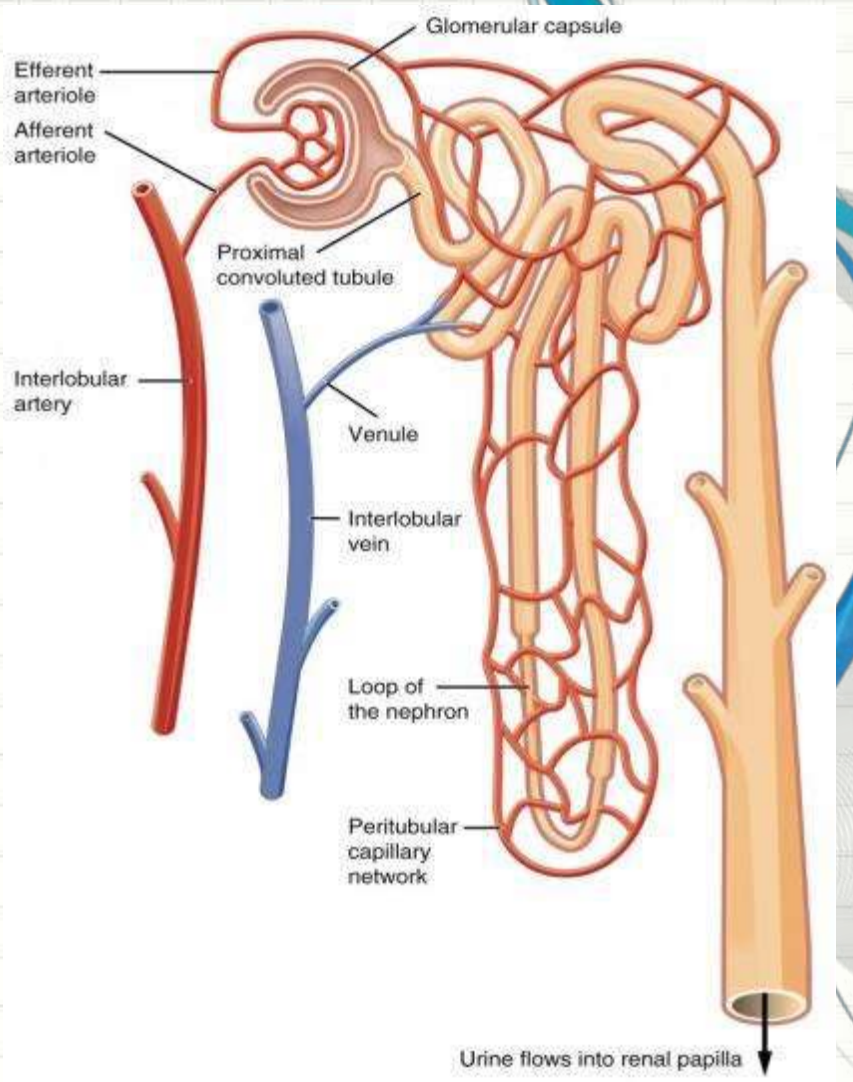

Distal convoluted tubule
Nephron loop
Proximal convoluted tubule
Renal corpuscle
Juxtamedullary nephron
Proximal convoluted tubule
Renal corpuscle (cut)
Glomerulus
Glomerular capsule
Distal convoluted tubule
Cortical nephron
Cortex
Thick descending limb
Thin descending limb
Thick ascending limb
Thin ascending limb
Nephron loop
Arcuate vessels
Nephron loop
Medulla
Collecting ducts
Papillary duct
Renal papilla
image via: pinterest.com


Peritubular capillaries
Efferent arteriole
Glomerulus
Afferent arteriole
Interlobular artery
Arcuate artery
Interlobar artery
Segmental artery
Renal artery
Interlobular vein
Arcuate vein
Interlobar vein
Renal vein

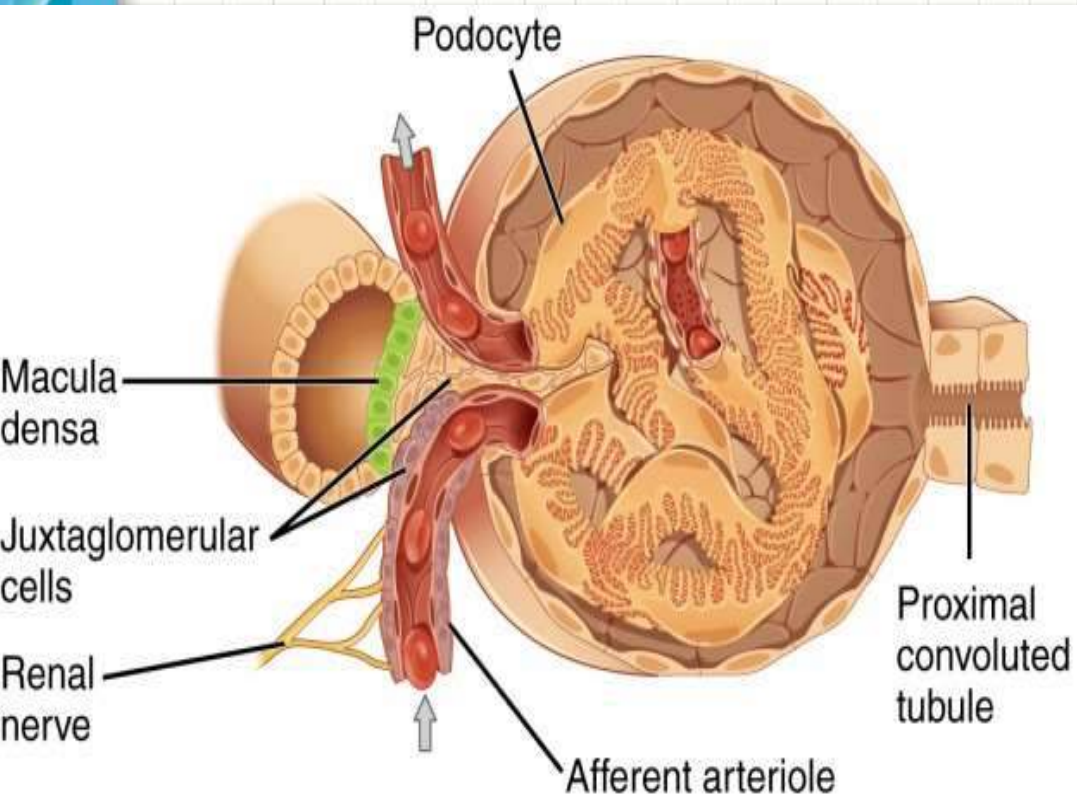
Anatomy/Function of the Kidney

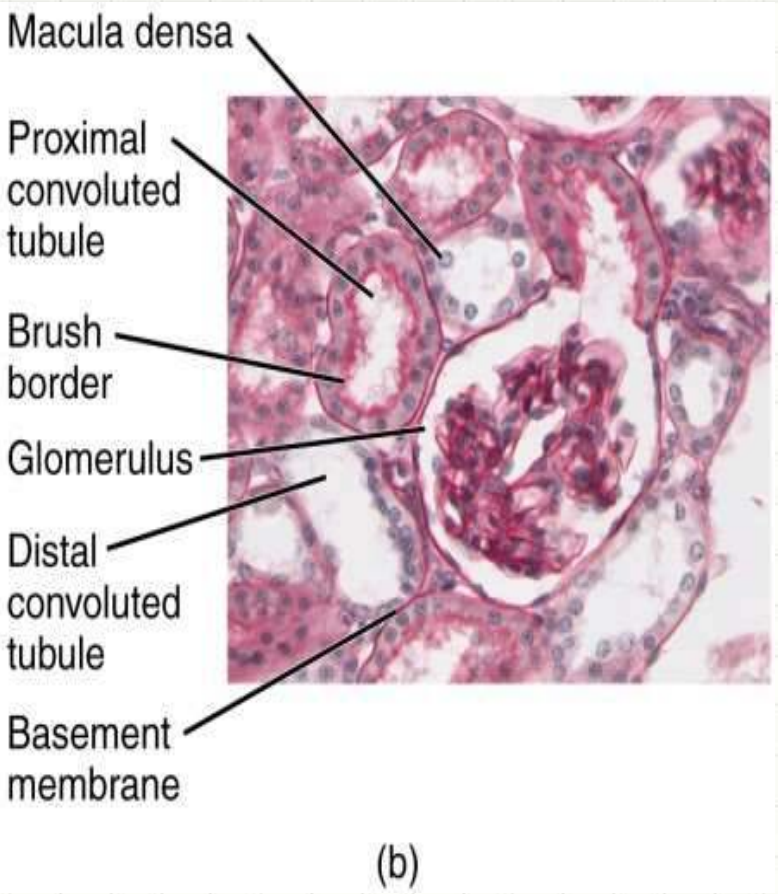
Closed end of tubule forms a bowl for the glomerulus

- Glomerulus is extension of capillaries, creates ultrafiltrate of blood that passes to Bowman's capsule
- Urine passes through collecting duct to renal pelvis
- Tubule
  - One-cell thick
  - Proximal tubule
  - Loop of Henle
  - Distal tubule
- 1 million nephrons/kidney



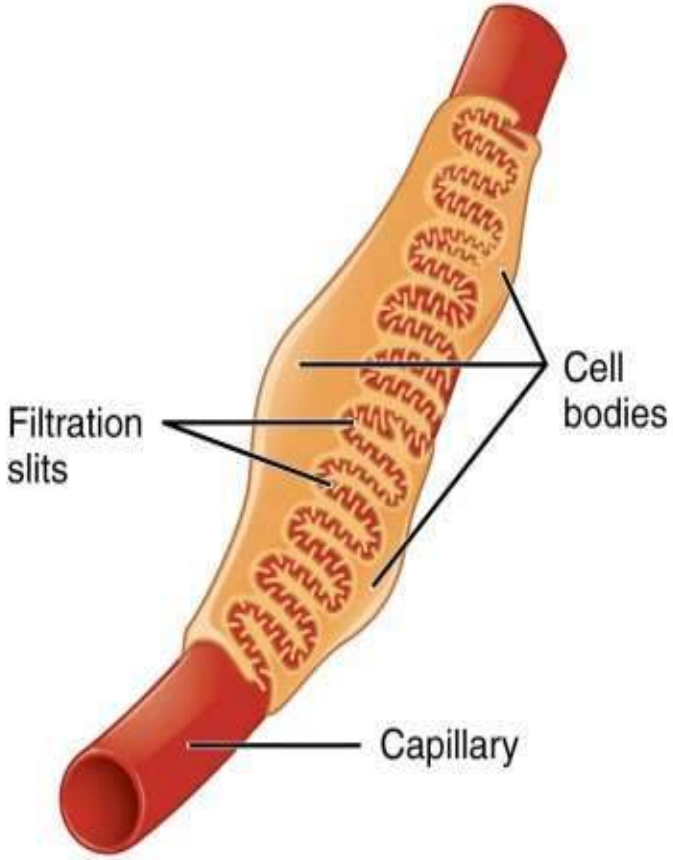
- Glomerular structure





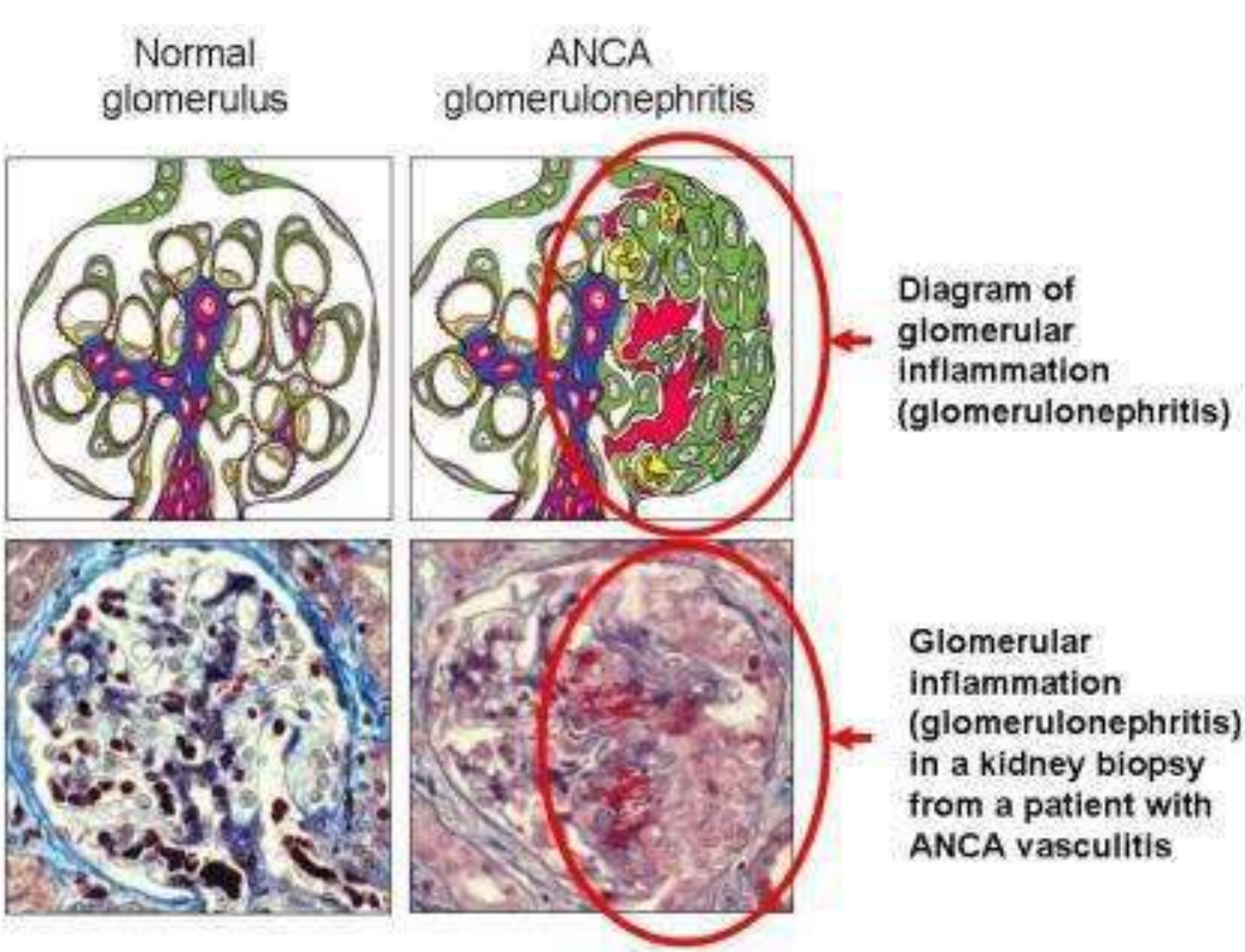
Podocytes interdigitate with structures called **pedicels** and filter substances in a way similar to fenestrations. In (a), the large cell body can be seen at the top right corner, with branches extending from the cell body. The smallest finger-like extensions are the **pedicels**. Pedicels on one podocyte always interdigitate with the pedicels of another podocyte. (b) This capillary has three podocytes wrapped around it.

(a)



(b)

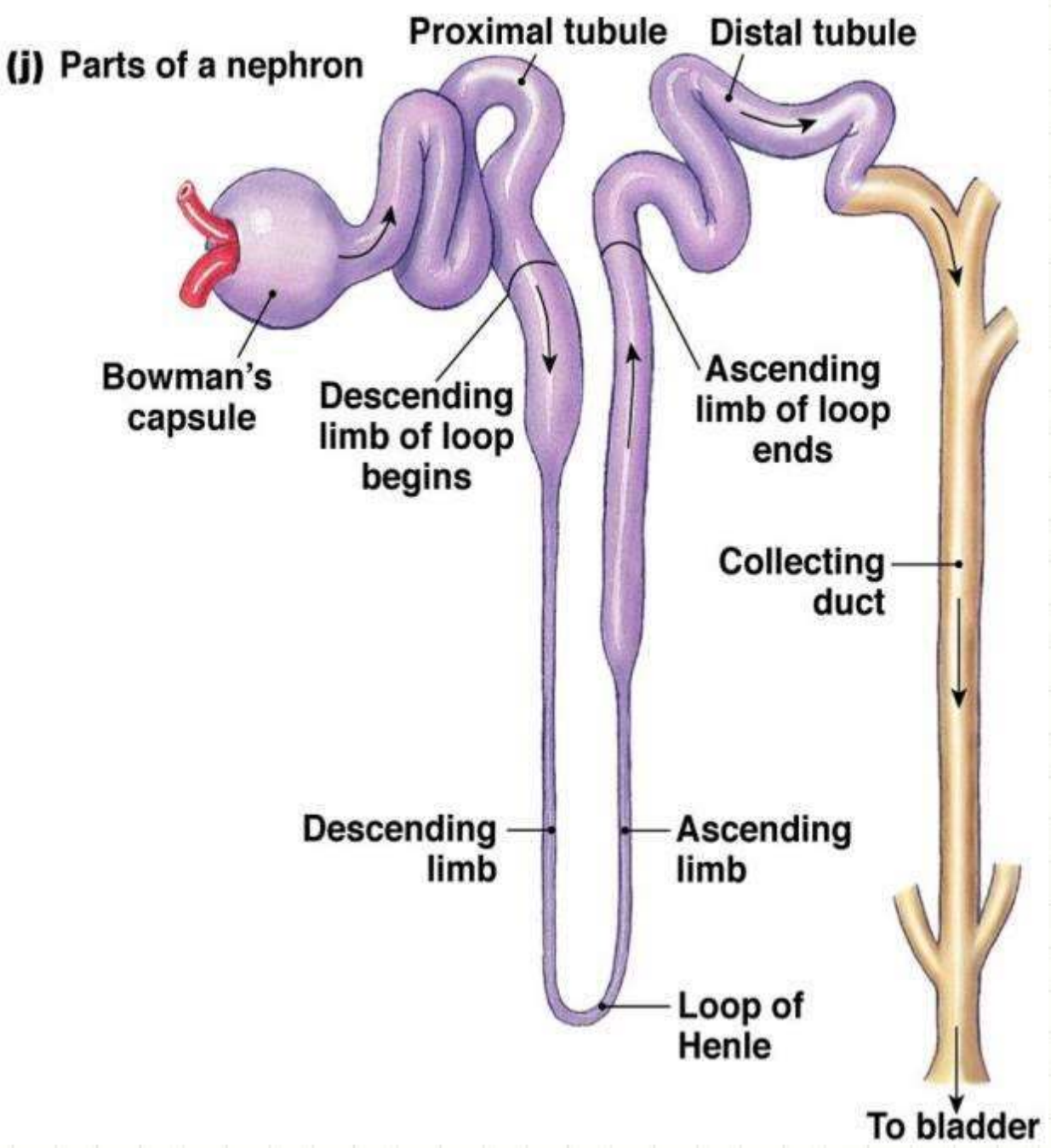
glomerulonephritis



Glomerular Filtration

- Filtrate excludes only red blood cells and large proteins
- Rate depends on: – Hydrostatic pressures – Colloid osmotic pressure – Hydraulic permeability
- Net pressure is +10 mm Hg
- Permeability very high – Capillaries fenestrated – Filtration slits in glomerulus

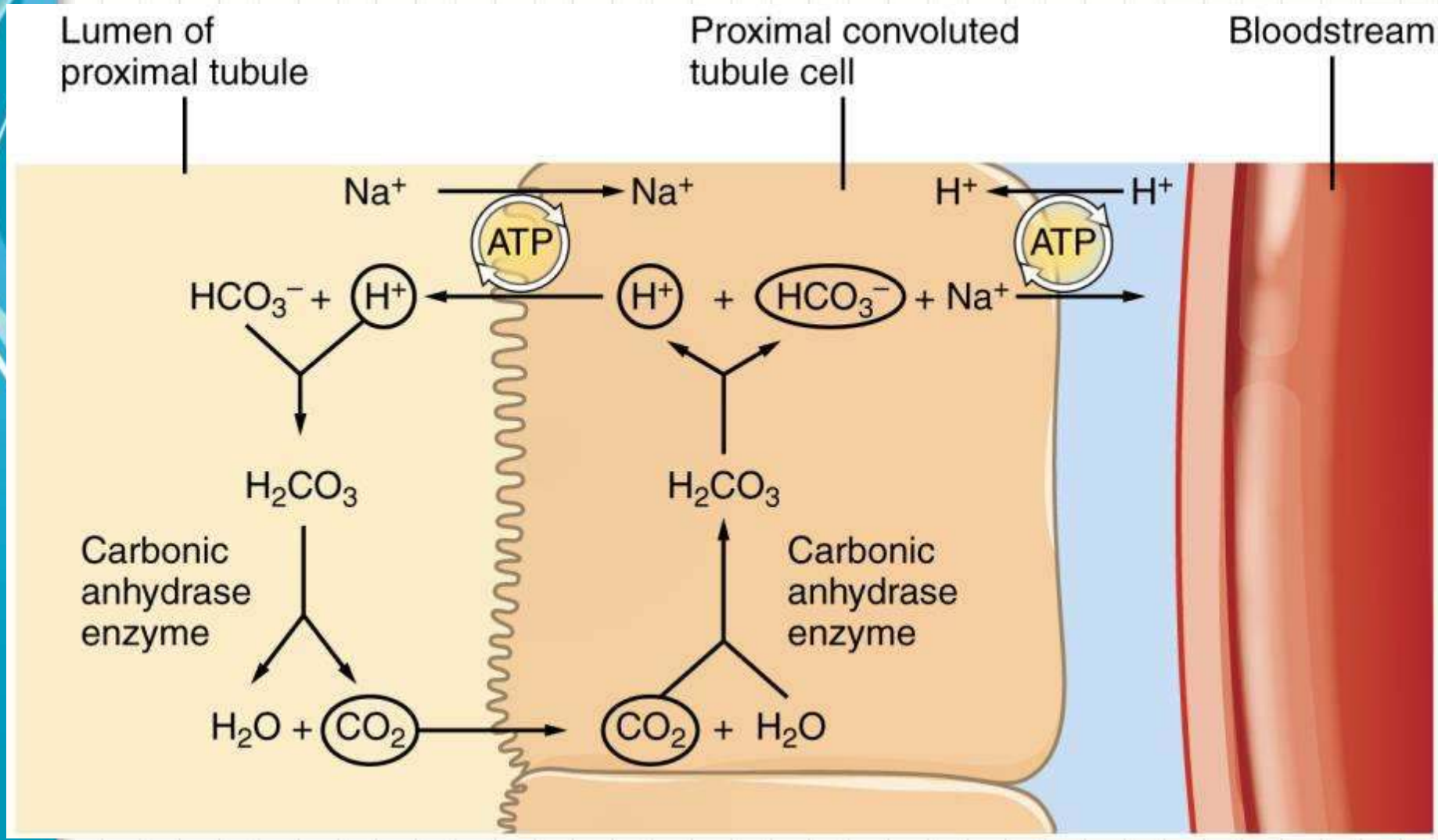
Nephron structure and functions



Main mechanism of nephron depend on

Osmoregulatory Organs: Prototypical Transport Systems and the Mammalian Kidney

Transport Systems: Prototype



Transport Systems: Specific Example

- ATPase removes Na+ and absorbs K+
- K+ diffuses and crosses into tubular lumen through special channels
- Net K transporter, driven by ATP-ase