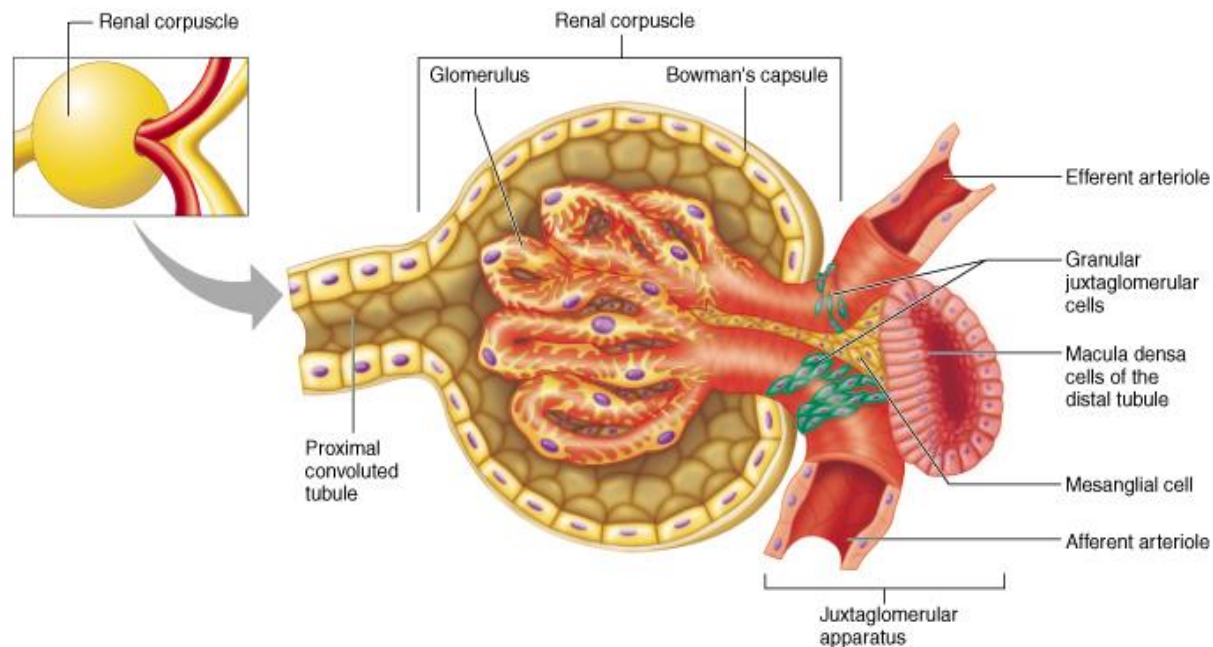


FUNCTIONAL ANATOMY, RENAL FUNCTIONS & GLOMERULAR FILTRATION



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LECTURE OUTLINES



- Physiological Anatomy of the Kidney
- Nephron / Renal Functions
- Juxta glomerular apparatus [JGA]
- Glomerular Membrane
- Glomerular Filtration
- Glomerular Filtration Rate [GFR]
- Normal GFR

APPLIED ANATOMY OF THE KIDNEY / NEPHRON



APPLIED PHYSIOLOGICAL ANATOMY OF THE KIDNEY / NEPHRON

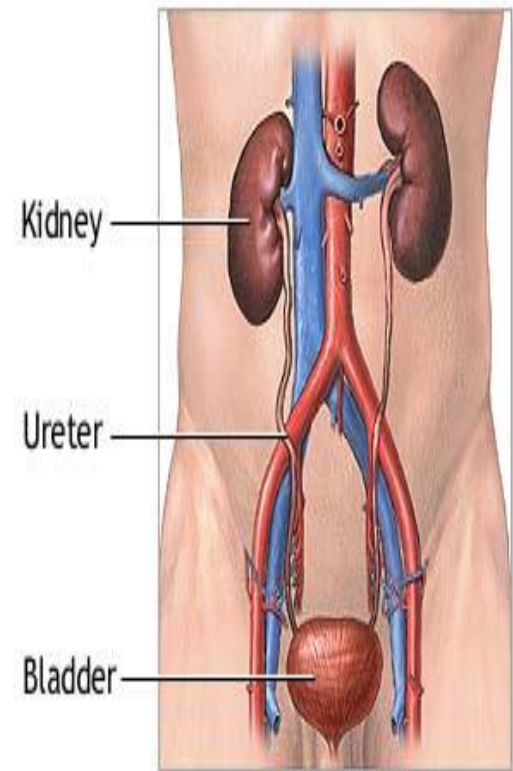
FUNCTIONAL ANATOMY OF KIDNEY / NEPHRON



■ Kidneys are a pair of excretory organs situated on the posterior abdominal wall on each side of the vertebral column.

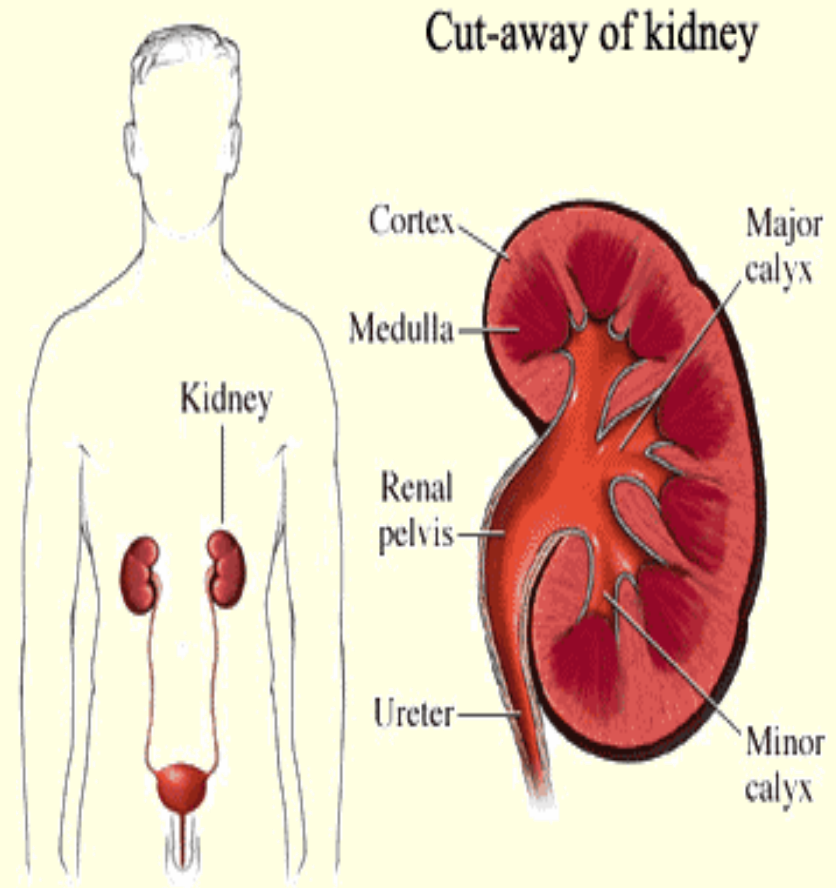
Located mainly in the lumbar region

Extend vertically from the upper border of the T_{12} vertebra to L_3 vertebra. The right kidney is slightly lower than the left.

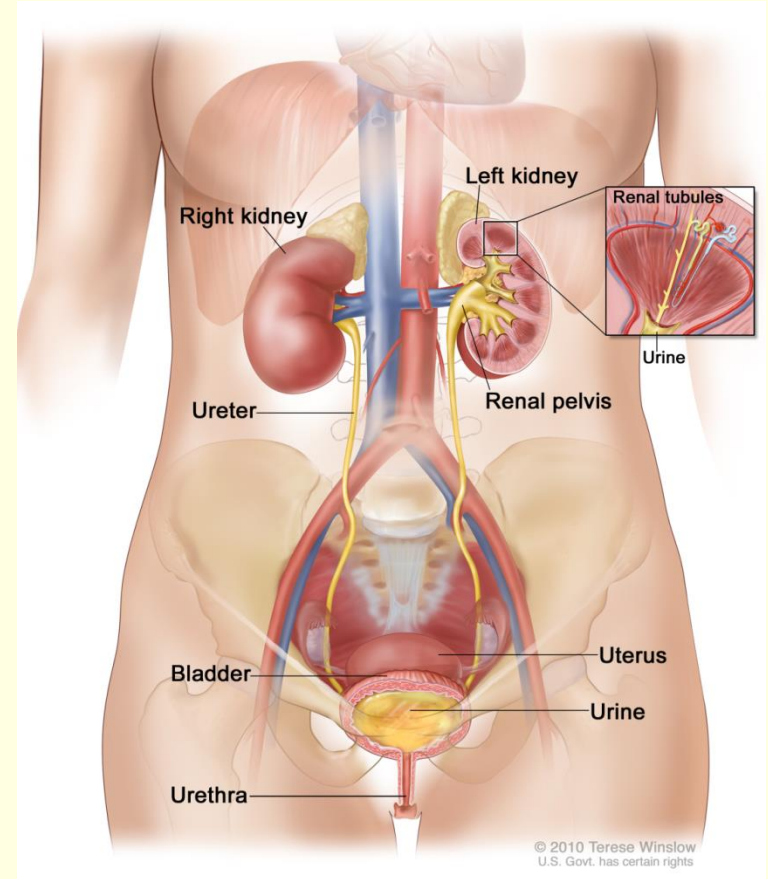
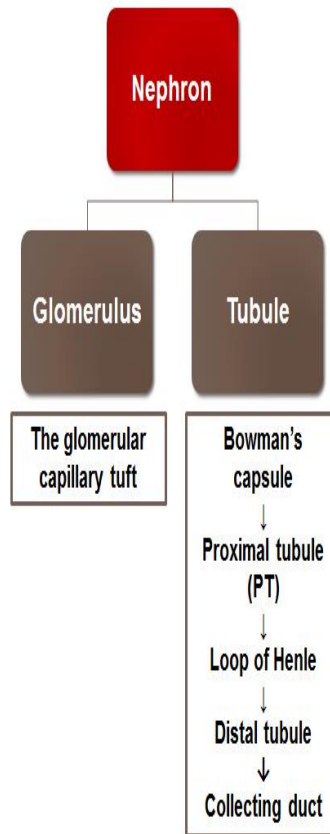
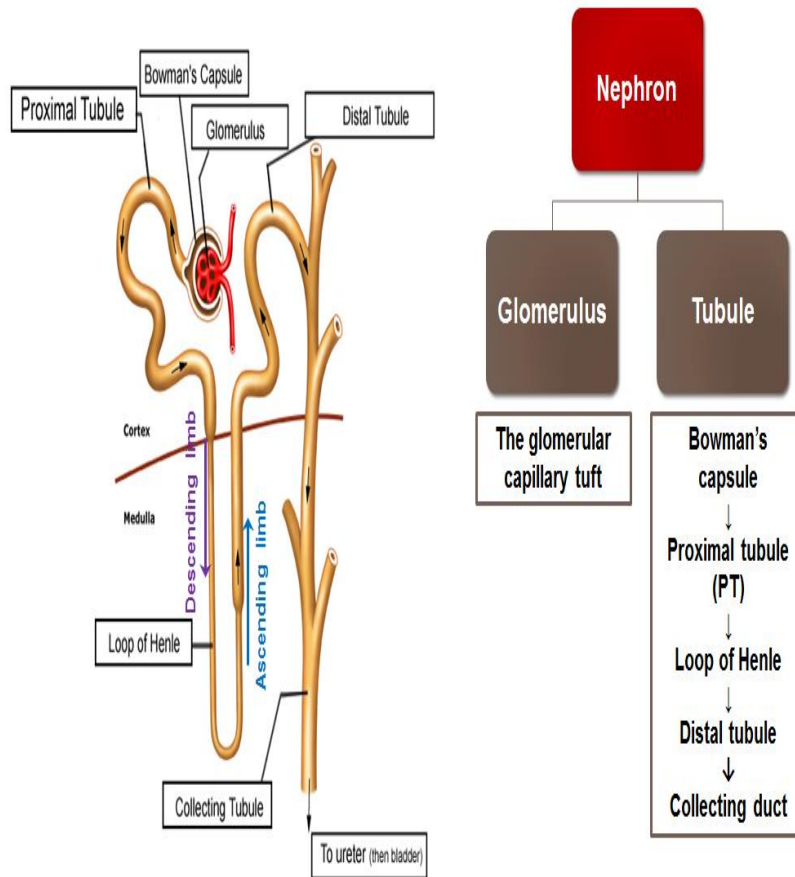


FUNCTIONAL ANATOMY OF KIDNEY / NEPHRON

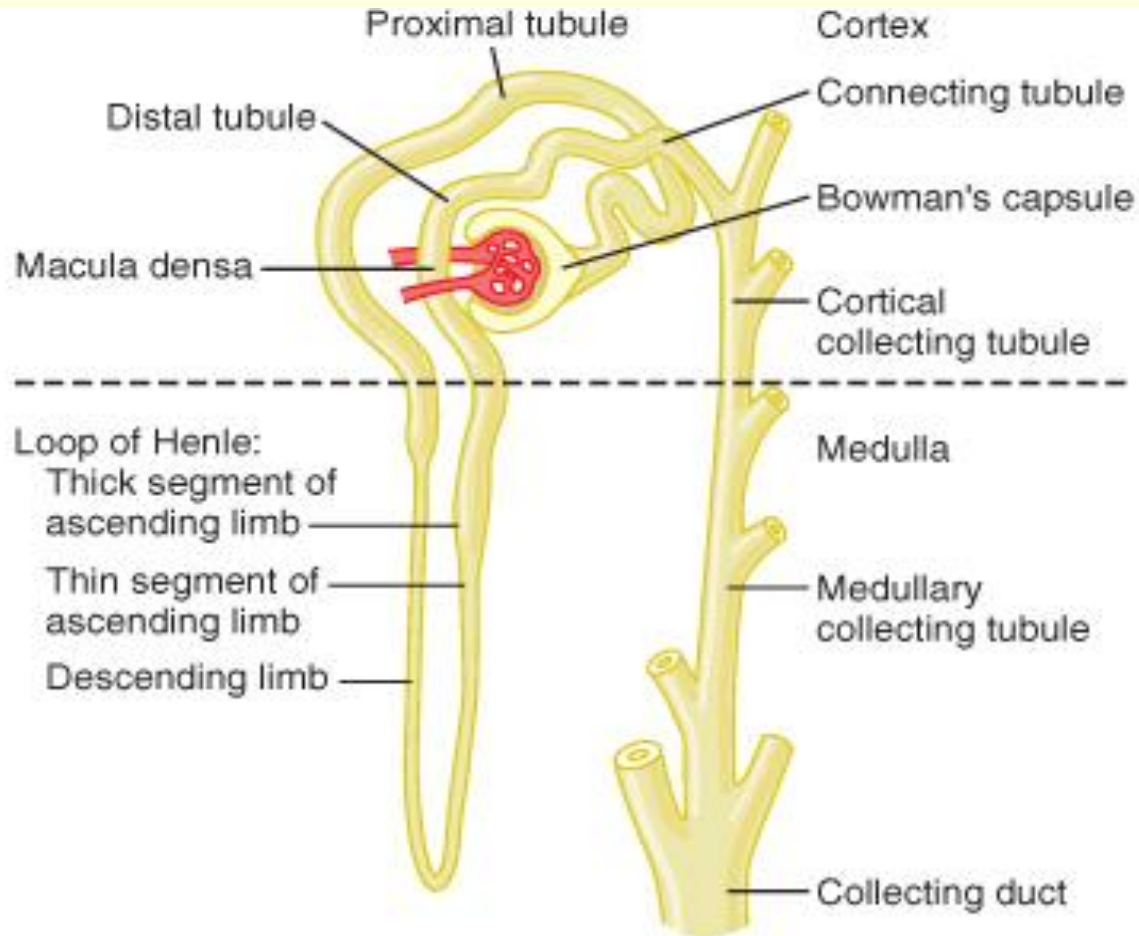
Each kidney is bean shaped. They are 12 cm long , 6 cm broad and 3 cm thick. The weight of each kidney is 150 gm in males and 135 gm in female.



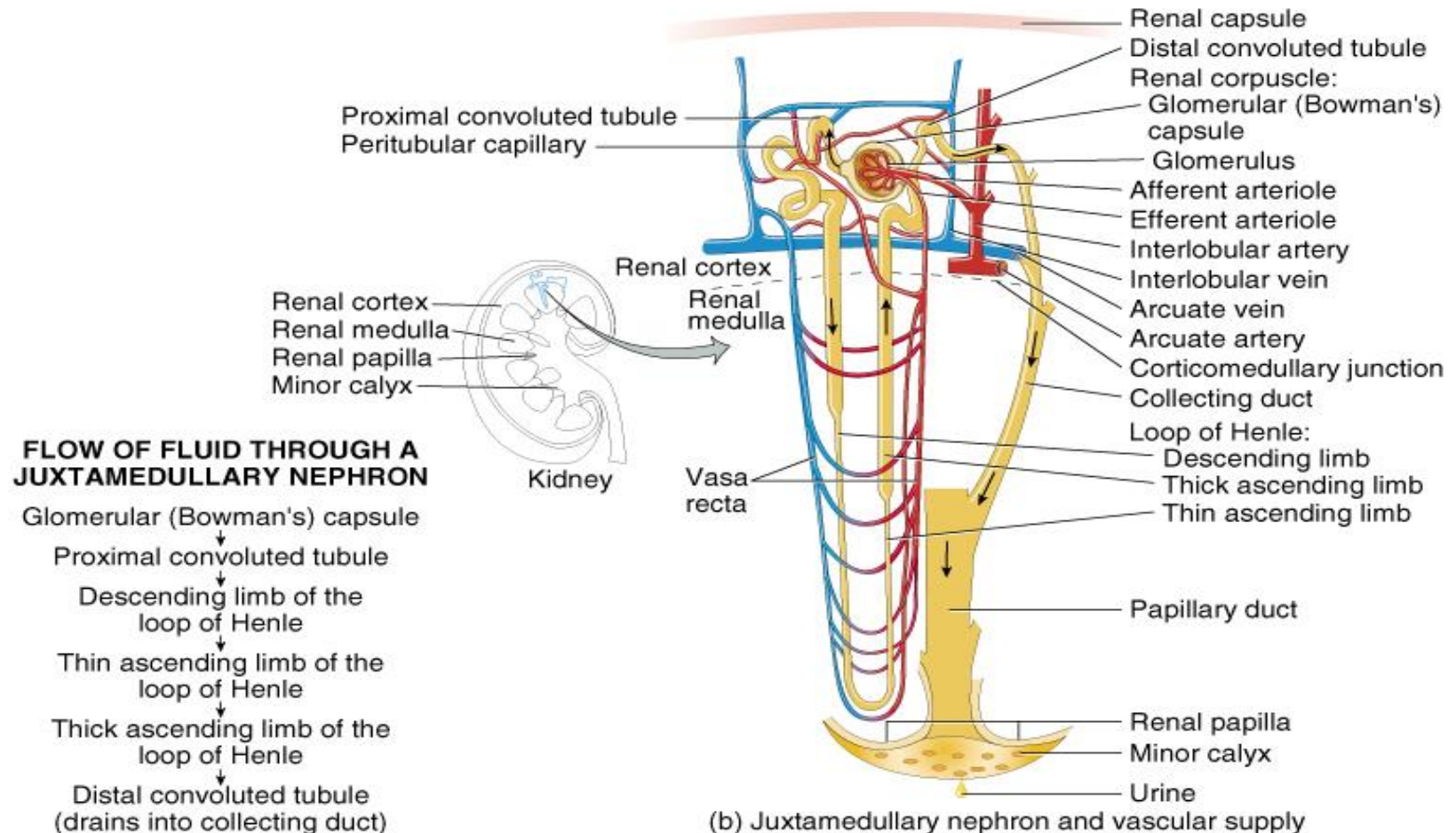
FUNCTIONAL ANATOMY OF KIDNEY / NEPHRON



FUNCTIONAL ANATOMY OF KIDNEY / NEPHRON



FUNCTIONAL ANATOMY OF KIDNEY / NEPHRON

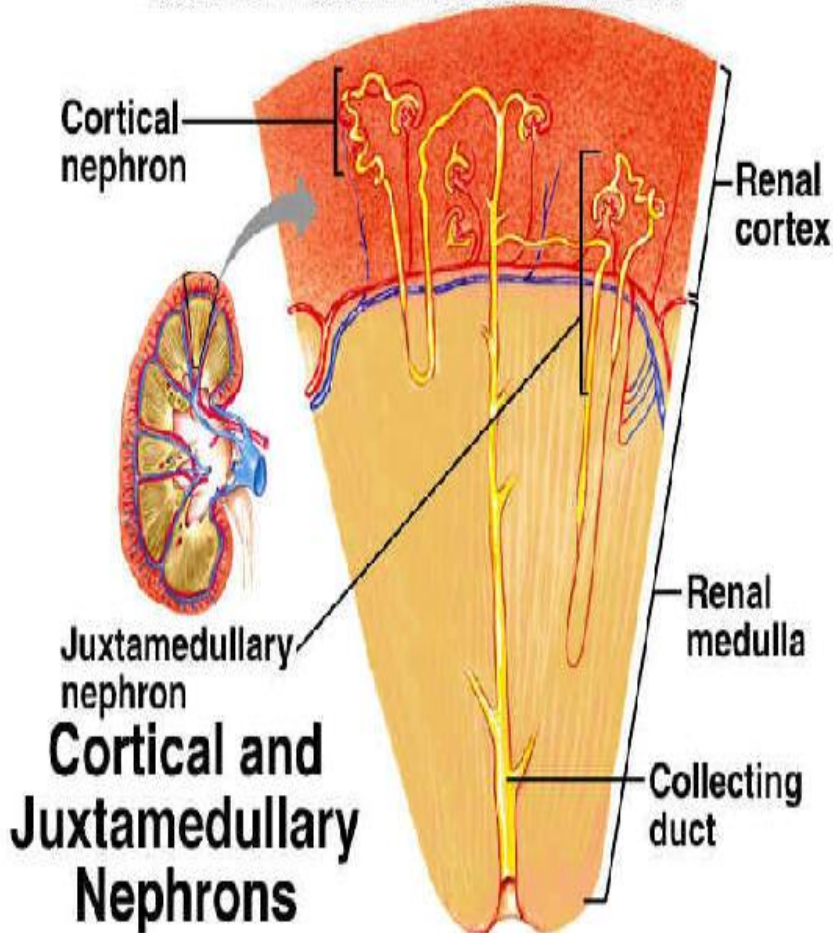


NEPHRON

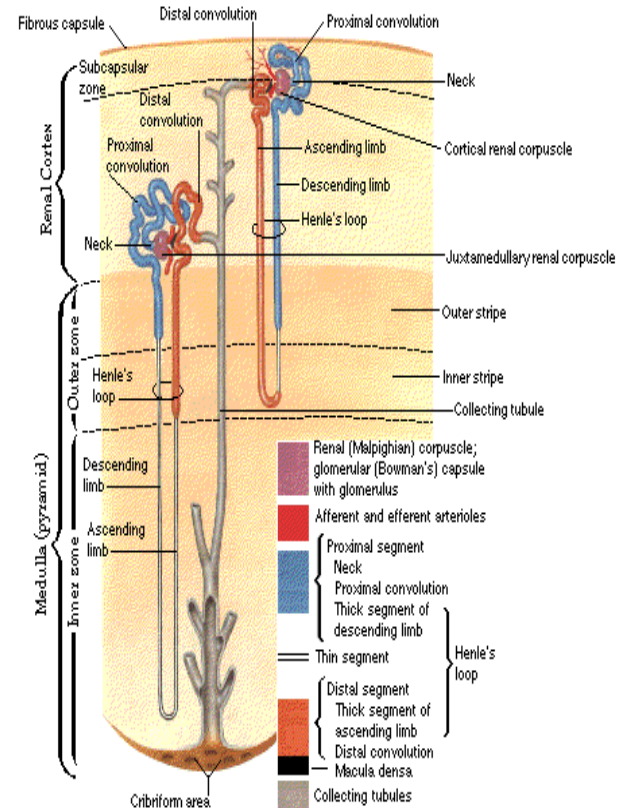
- Each kidney contains about 1.2 million nephrons, each capable of forming urine.
- 8 to 10 cortical collecting ducts join to form a single larger collecting duct that runs downward into the medulla and becomes the medullary collecting duct.
- After age of 40 years the number of functioning nephrons usually decreases about 10 % every 10 years

NEPHRON

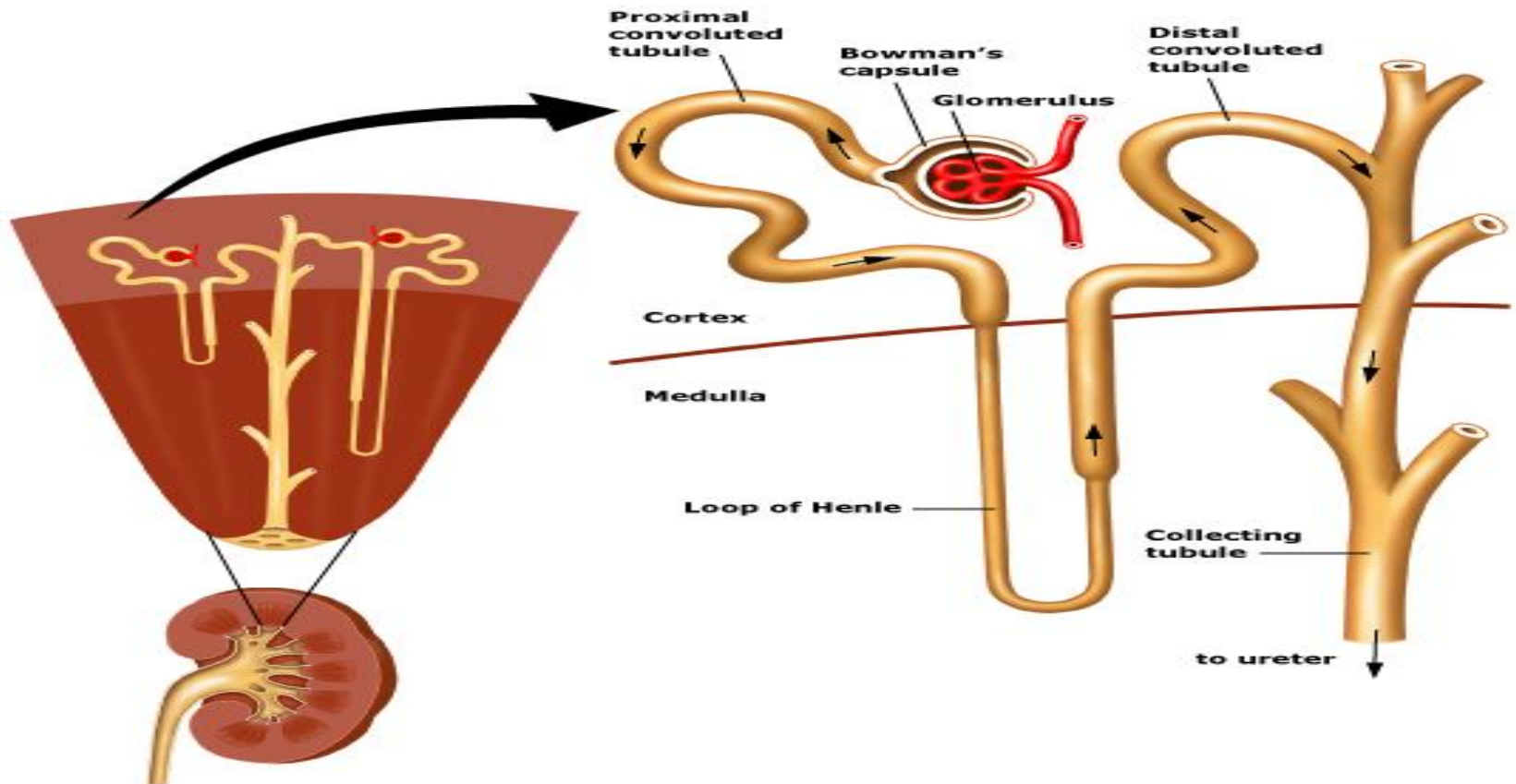
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Nephron and Collecting Tubule Schema



NEPHRON



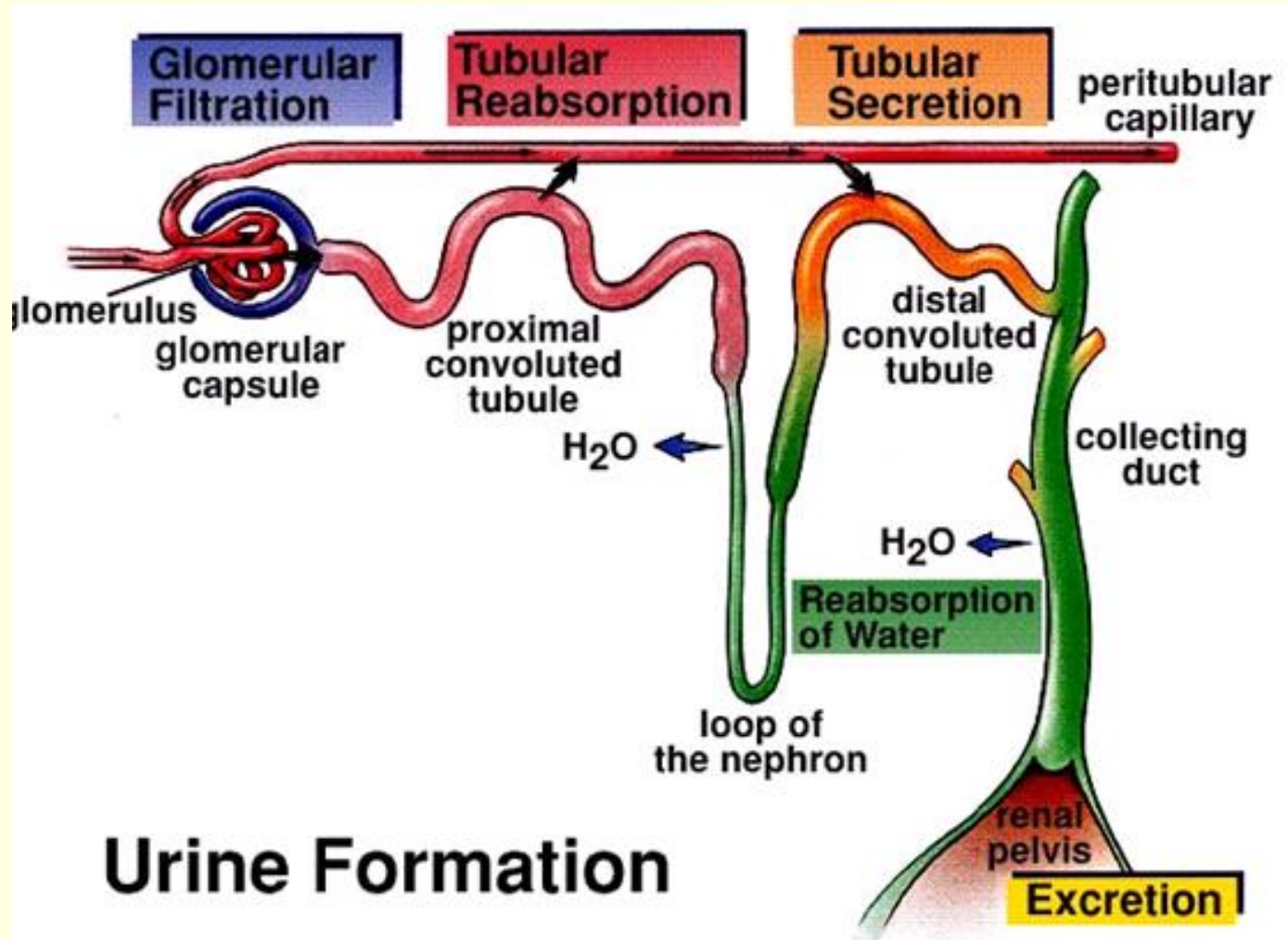
- Superficial (cortical [85 %]): Capable of forming dilute urine
- Juxtamedullary [15 %]: Capable of forming concentrated (300 mOsm/kg) urine

TYPES OF THE NEPHRON

1. Cortical nephrons: These nephrons glomeruli lie close to the surface of the kidneys. Comprise about 85% of the nephrons in the kidneys and glomeruli located in the renal cortex. The cortical glomeruli is **small and have short thin segments** and their loops of Henle penetrate a short distance into the outer portion of the medulla.

2, Juxta medullary nephrons: Comprise of about 15% of nephrons **and have long thin segments and their loops of Henle penetrate deep into the inner portion of the medulla.**

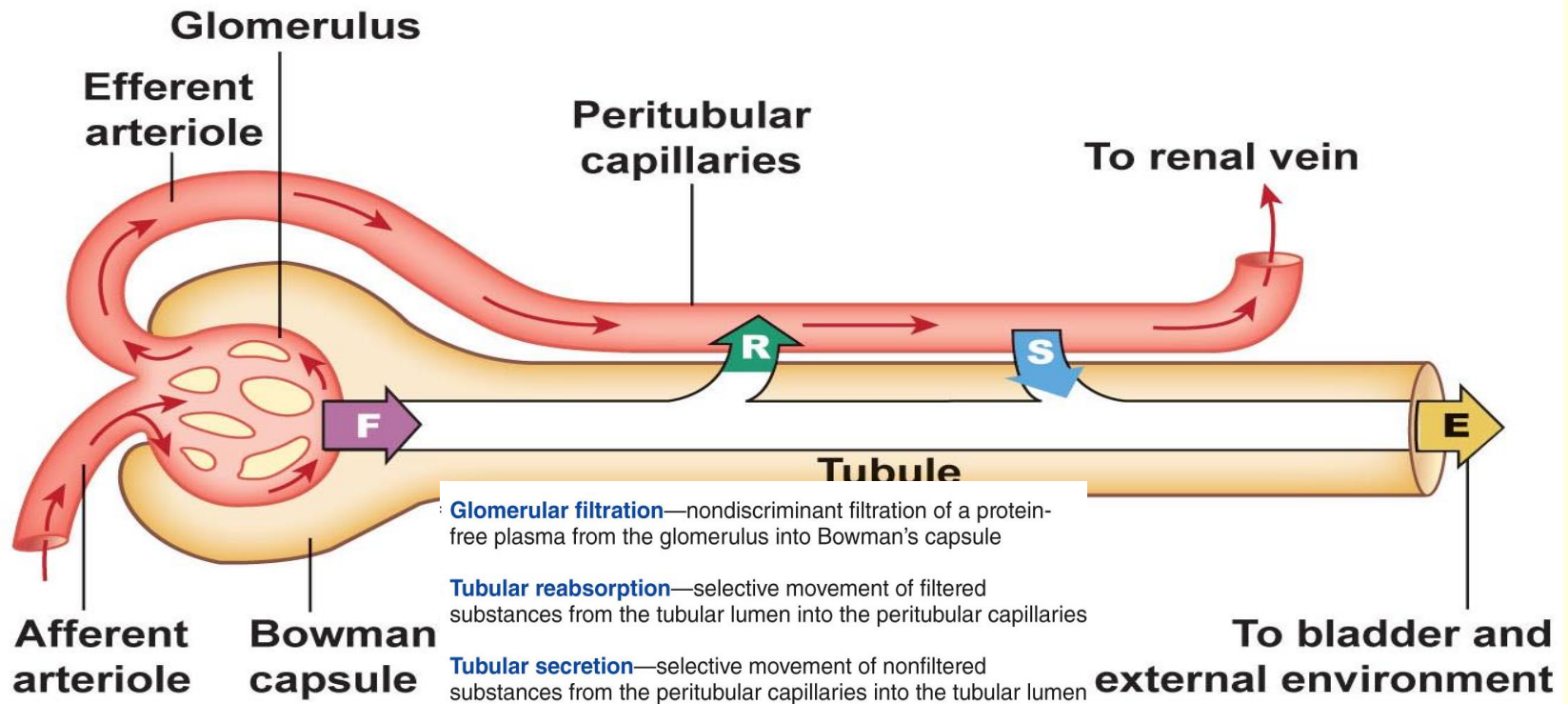
THE NEPHRON



THE NEPHRON

SIMPLIFIED FUNCTIONS

- **Glomerular Filtration:** From GI to BC
- **Tubular Reabsorption:** From Tubule to PC
- **Tubular Secretion:** From PC into tubules
- **Excretion:** From tubules to bladder

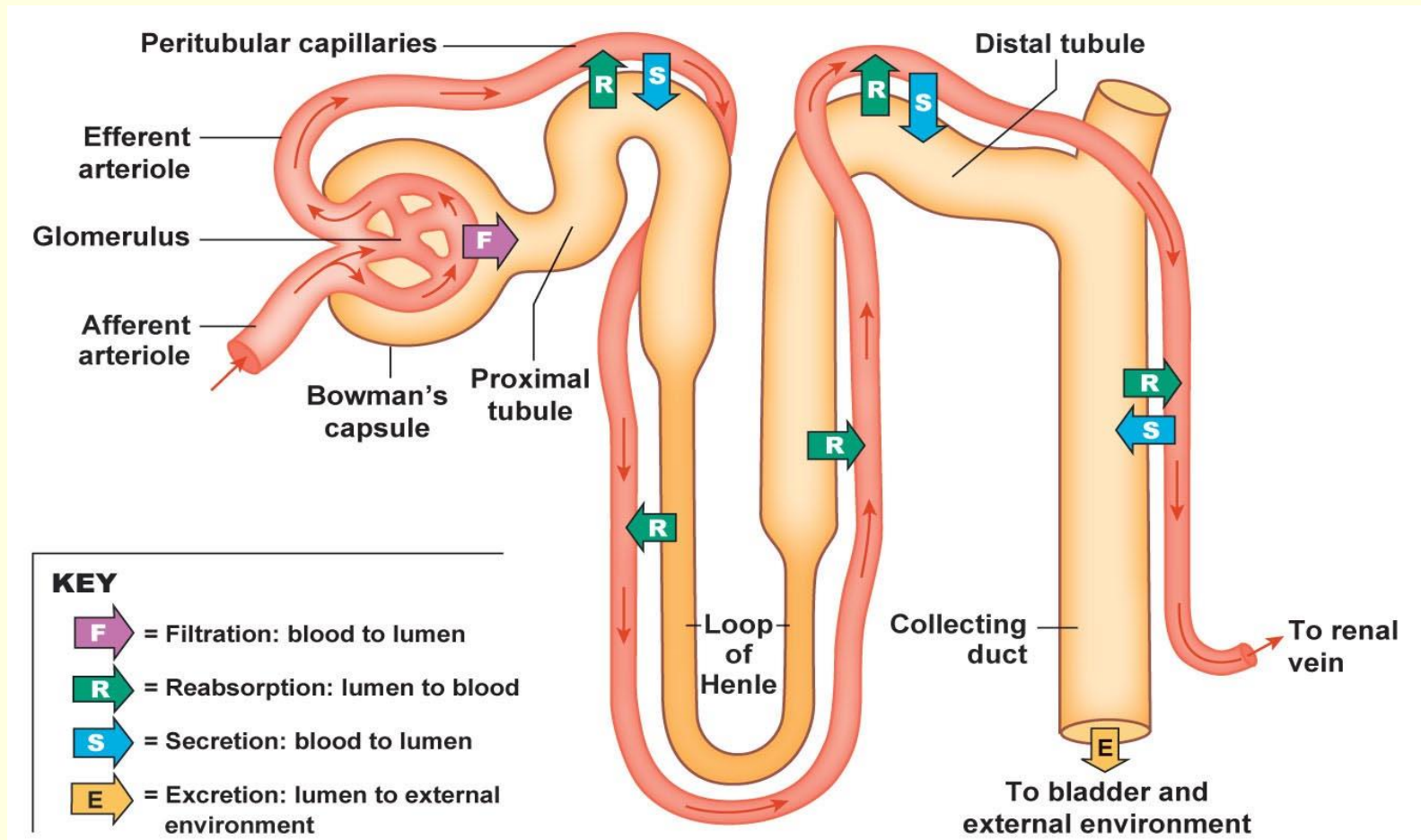


Amount filtered	-	amount reabsorbed	+	amount secreted	=	amount of solute excreted
F		R		S		E

Excretion = Filtration - Reabsorption + Secretion

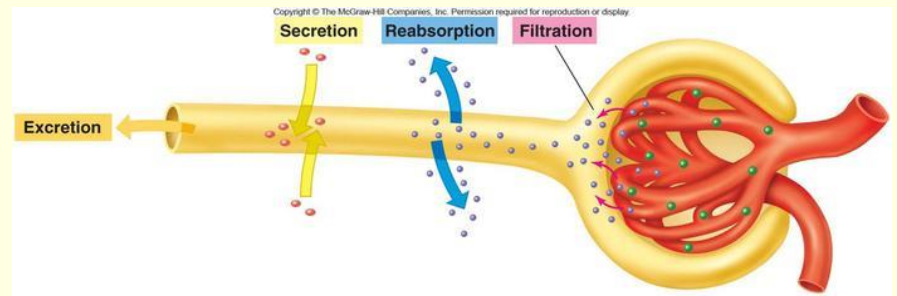
THE NEPHRON

FILTRATION, REABSORPTION, SECRETION & EXCRETION

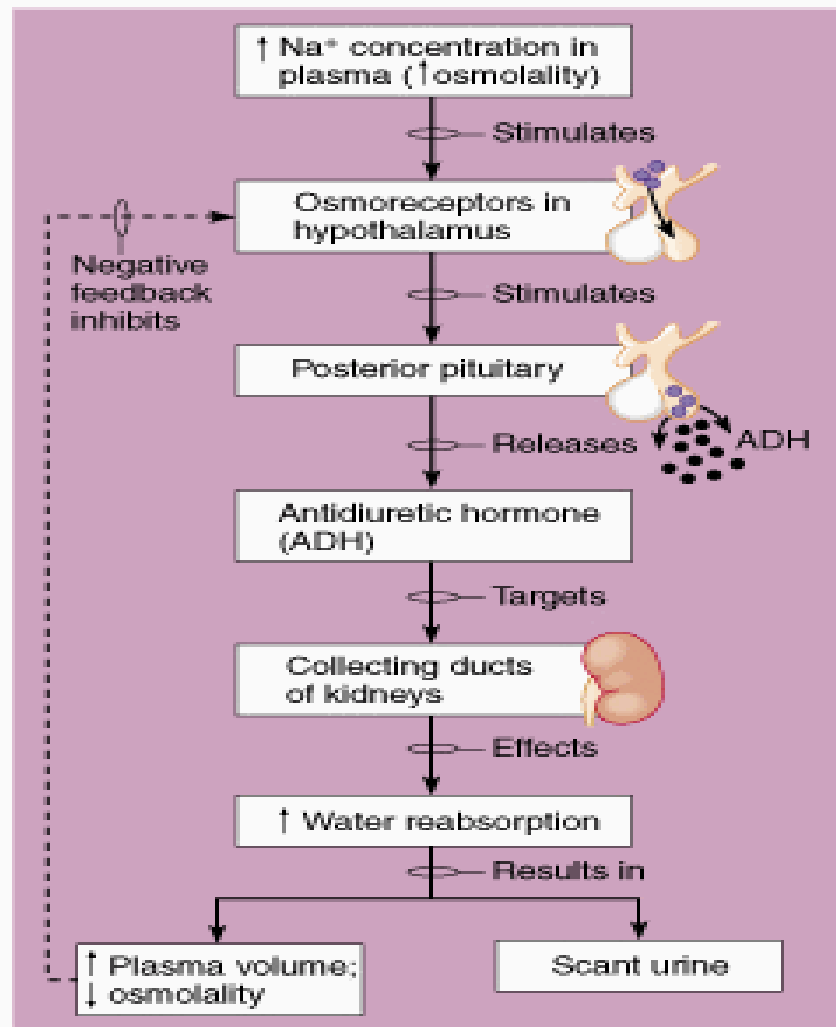


FUNCTIONS OF KIDNEY

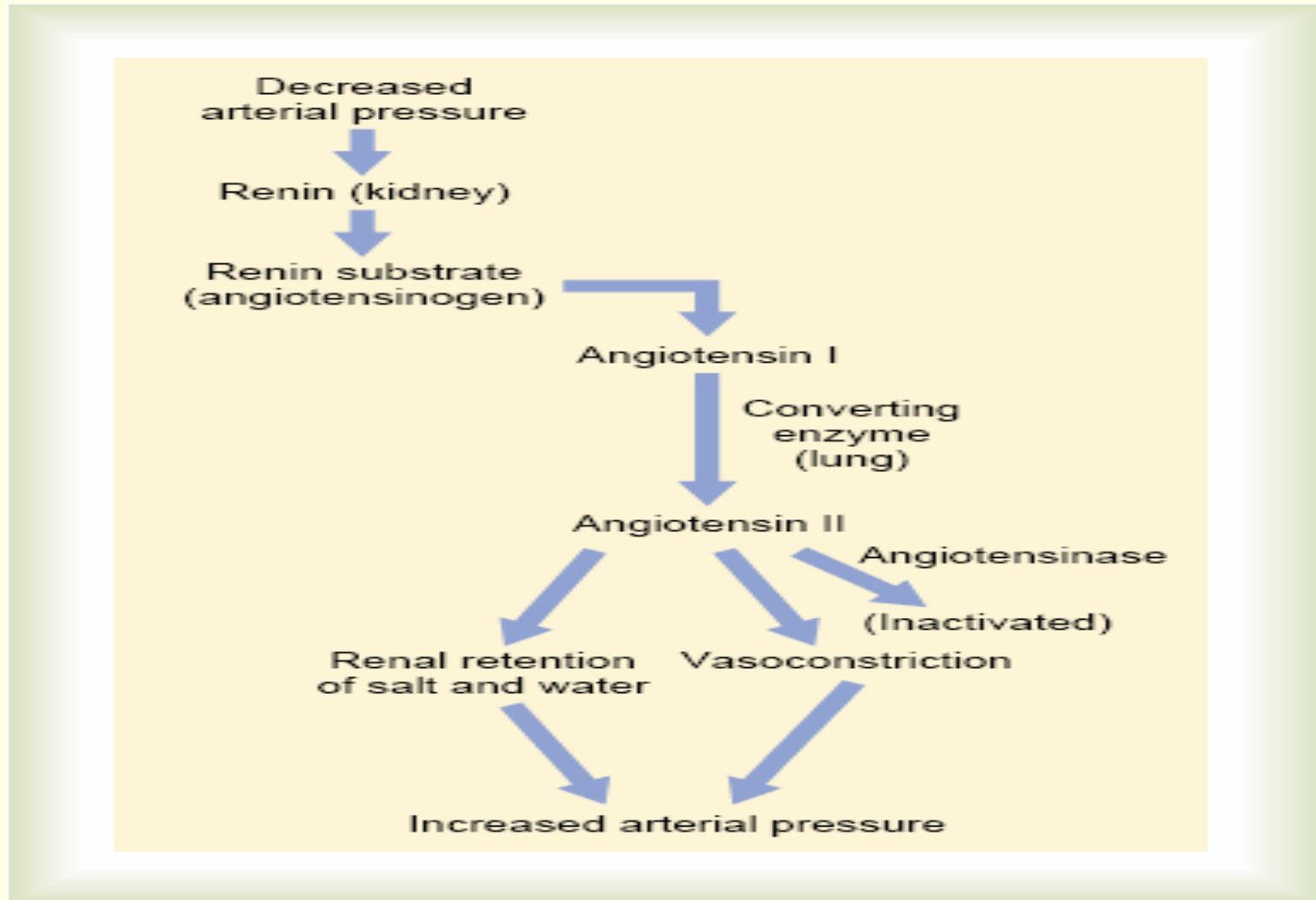
- Excretion of waste products [creatinine, urea]
- Regulation of water [extracellular fluid volume] homeostatic function of the kidney
- Maintenance of Electrolyte balance [Na^+ , K^+ , HCO_3^- , Ca^{++}]
- Regulation of arterial pressure and Regulation of blood pH
- Secretion, metabolism, and excretion of hormones
- Hormone production [Erythropoietin, Renin]
- Activation of Vitamin D



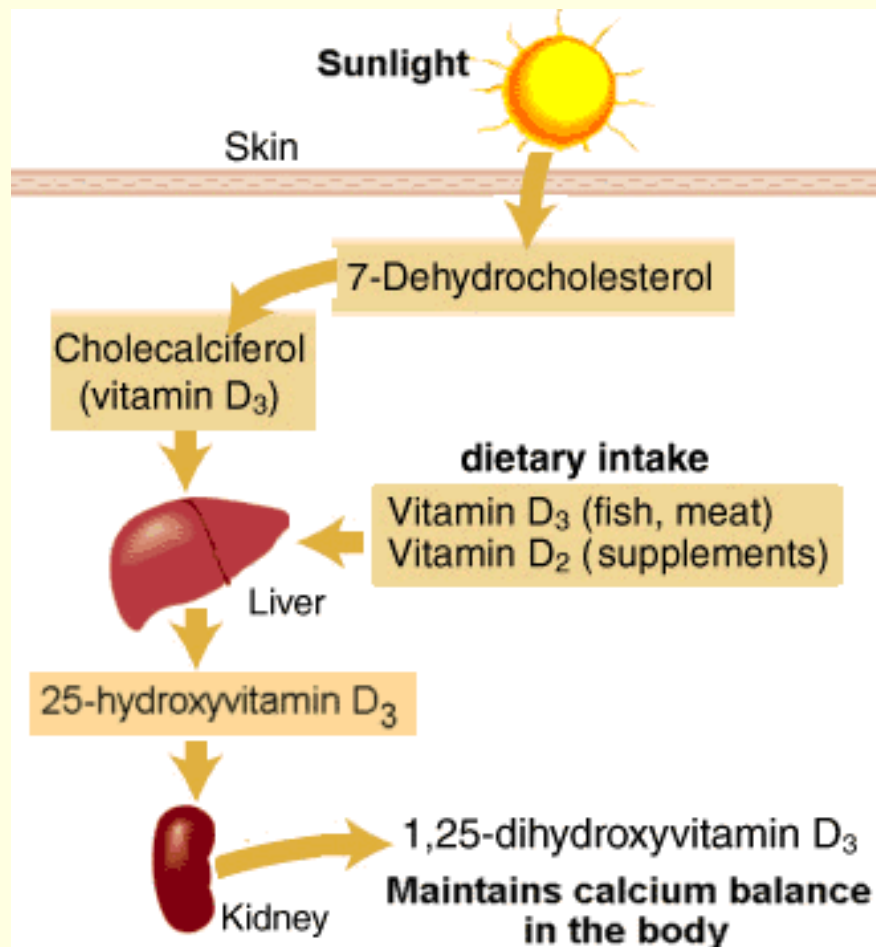
FUNCTIONS OF KIDNEY



FUNCTIONS OF KIDNEY



FUNCTIONS OF KIDNEY



Vitamin D₃ is metabolized by the liver to 25(OH)D, which is then converted by the kidneys to 1,25(OH)₂D (1,25-dihydroxycholecalciferol, calcitriol, or active vitamin D hormone). 25(OH)D, the major circulating form, has some metabolic activity, but **1,25(OH)₂D is the most metabolically active.**

FUNCTIONS OF KIDNEY

Synthetic function

Glucose
(gluconeogenesis)

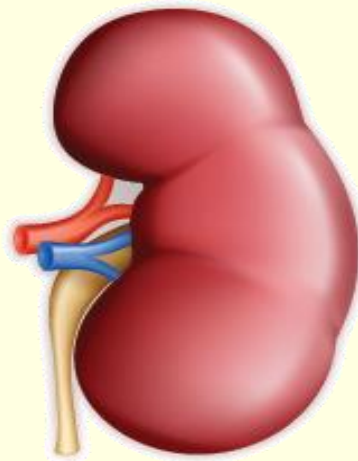
Erythropoietin

Renin

1,25-dihydroxy
vitamin D3
(calcitriol)

Excretion

Metabolic waste
products



Metabolic waste products:

Urea
Creatinine
Uric acid
Bilirubin

Ingested toxins:

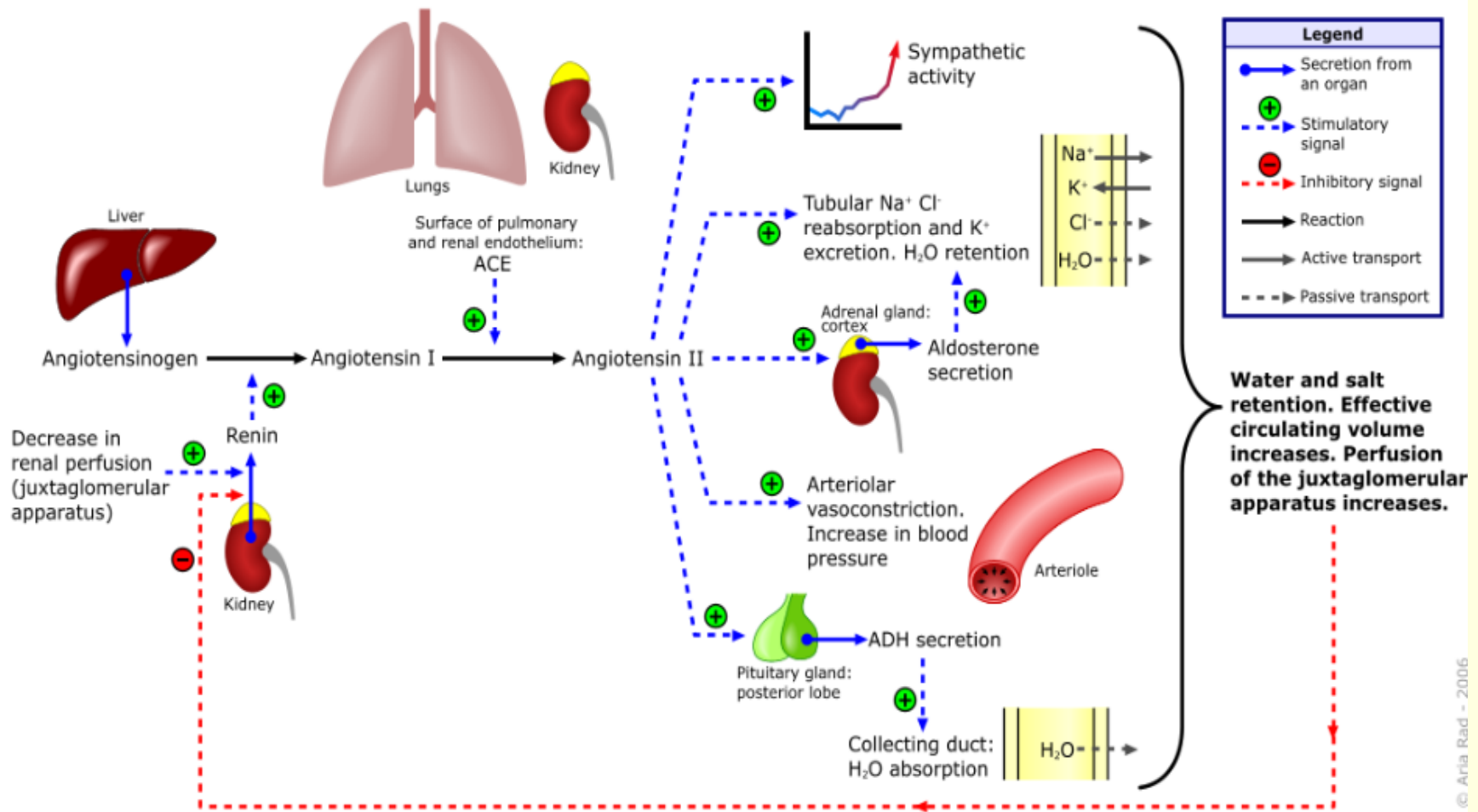
Drugs
Pesticides

Regulation

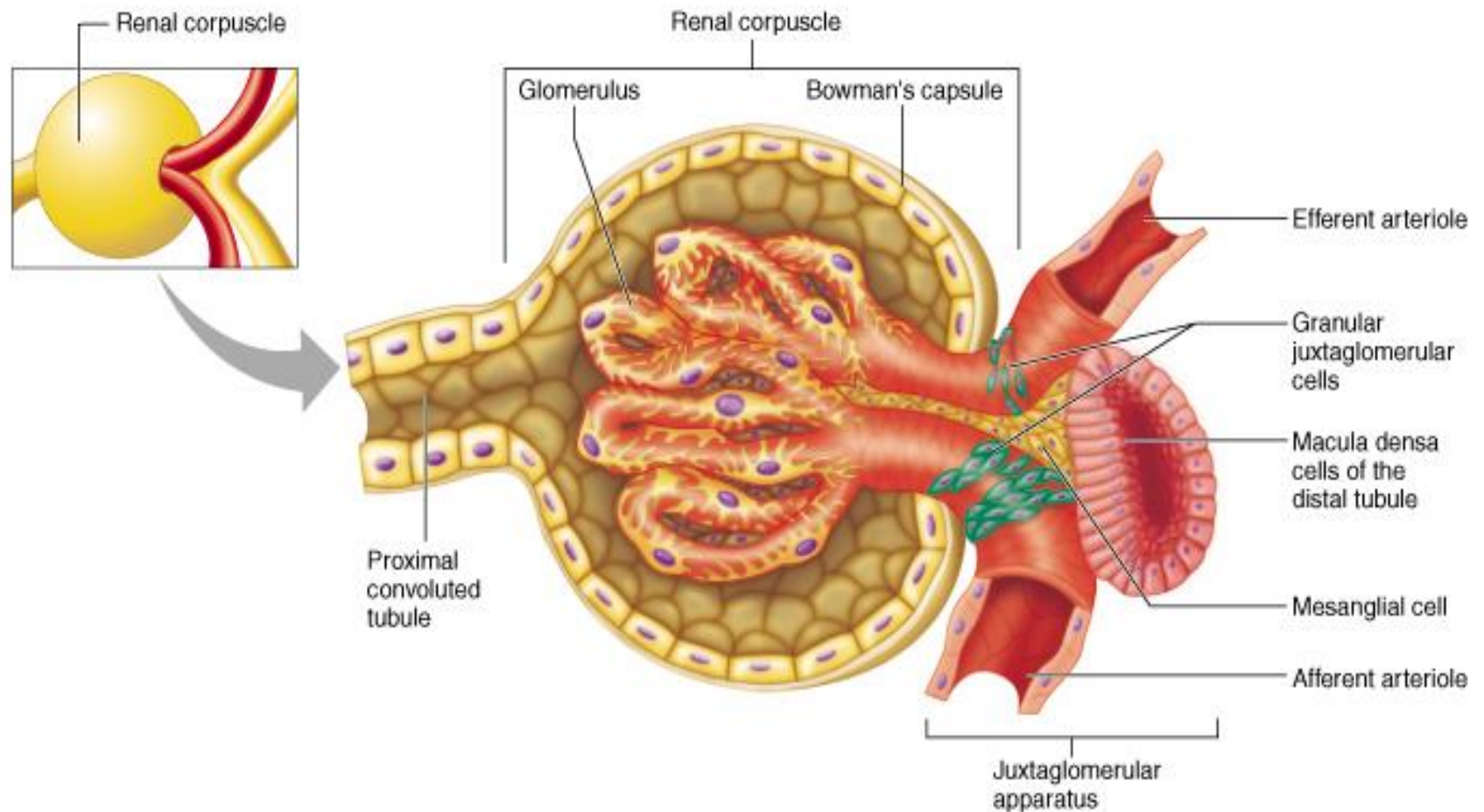
Water
Electrolytes
Acid-base
Arterial BP

Renin Angiotensin and Aldosterone function

Renin-angiotensin-aldosterone system



JUXTAGLOMERULAR APPARATUS [JGA]



JUXTA GLOMERULAR APPARATUS

JUXTA GLOMERULAR APPARATUS

This is the combination of structures/cells lying close to the glomerulus. The components of the juxta-glomerular apparatus play a role in the control of blood pressure, renal blood flow, Electrolytes balance and Erythropoiesis.

Structures forming the juxtaglomerular apparatus

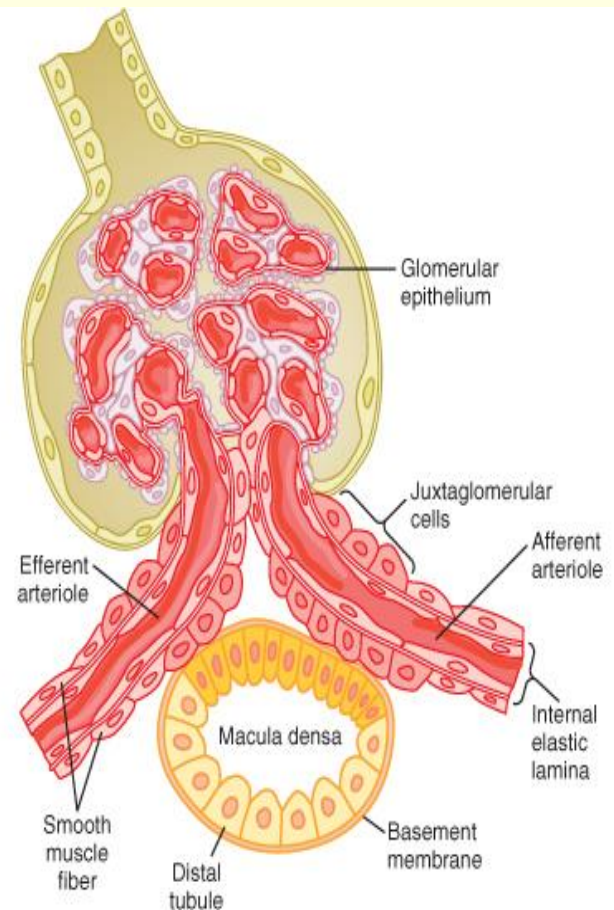
- Macula densa of the distal convoluted tubule
- The lacis cells

- The JG cells
- JGA adopt GFR to distal tubular or NaCl and also aides in adjusting as well as synthesizing renin release.

JUXTRA GLOMERULAR APPARATUS

Macula densa

The macula densa is a group of modified epithelial cells in the portion of the distal convoluted tubule lying in contact with the afferent glomerular vessel of the same nephrons.



JUXTRA GLOMERULAR APPARATUS

The lacis cells: These cells also known as **polkissen cells**
These cells lie in **close contact with the macula densa and also within the vascular pole formed by the afferent and efferent glomerular vessels**

The Lacis cells are supportive cells, transfer information about NaCl, tubular load to the granular cells and may be involved in tubulo-glomerular feedback regulation

JUXTRA GLOMERULAR APPARATUS

The juxta glomerular cells

Are granular epitheloid cells

Located in the pro-glomerular part of the afferent and occasionally the efferent arterioles.

Renin secretion is determined by the degree of stretch of the afferent glomerulus and also by the Na^+ concentration in the macula densa.

These cells synthesize, store and secrete renin

THANK YOU

